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Amazon Vertical City: The fulfillment center of the future

Jessica Casero Lopez
Syracuse University

amazon vertical city

the fulfillment center of the future

jessica casero lopez

Amazon Vertical City

Jessica Casero Lopez

Primary Advisor:
Nicole McIntosh

Secondary Advisors:
Gregory Corso
Jonathan Louie

Syracuse University School of Architecture

Special thanks to Tom Brossi

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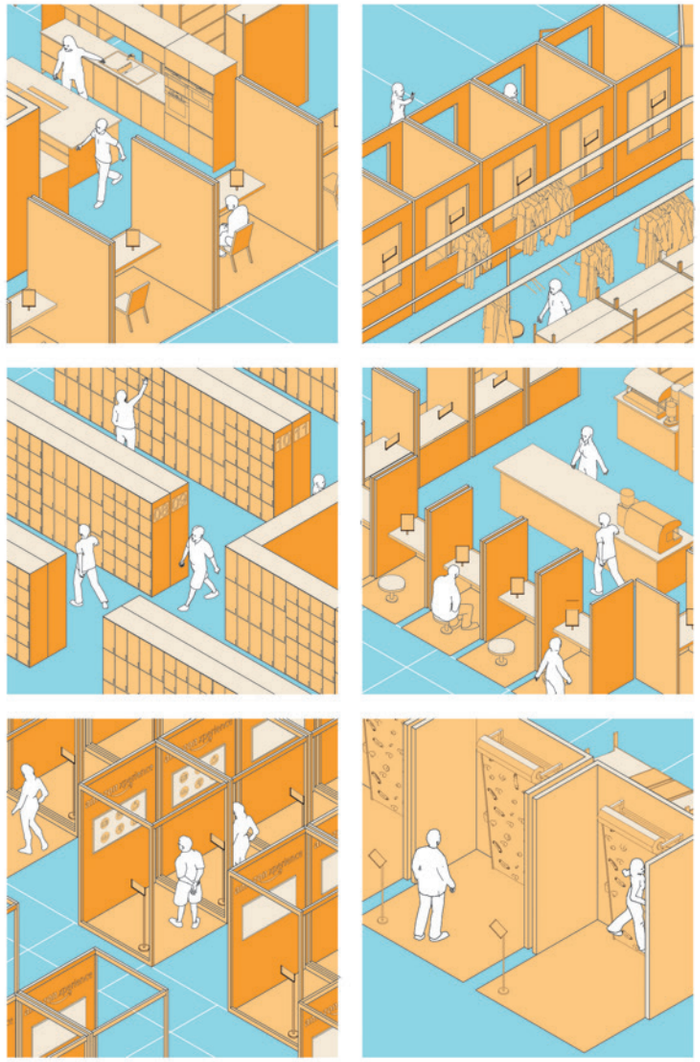


amazon vertical city

the fulfillment center of the future

This thesis project looks at the projection of Amazon's patent drawings for vertical fulfillment centers and speculates on their design to evolve into a significant typology in the present day.

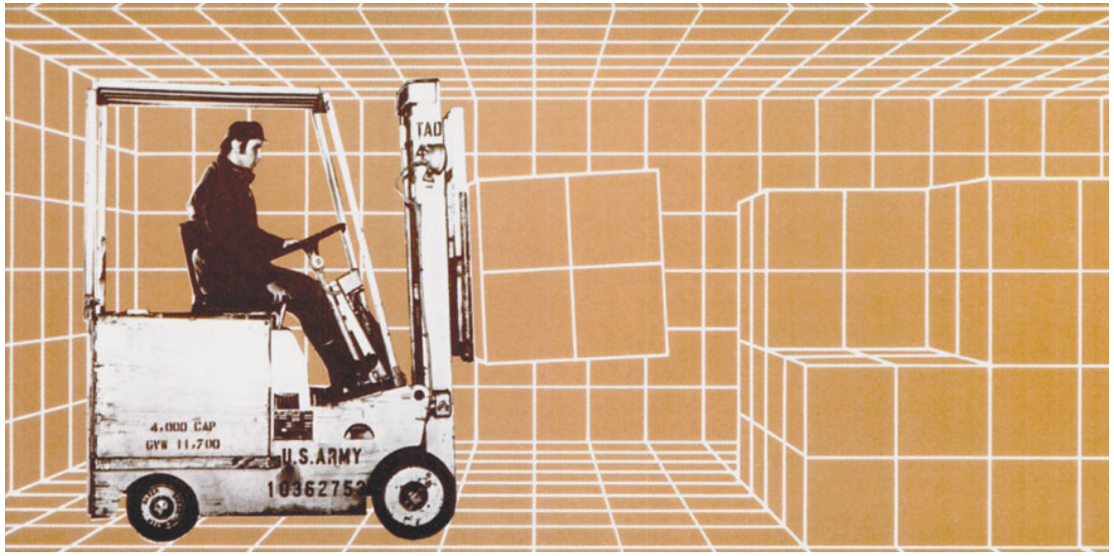
In June of 2017, Amazon released one of their most compelling patents, a multi-level fulfillment center with a beehive structure for Unmanned Aerial Vehicles. The release of drawings made international news. These could change the way distribution centers are perceived and designed. Amazon is the world's largest online retailer. In 2017, Amazon had 300 million users worldwide. Rapid growth has enabled Amazon to expand to different continents and forced them to open new fulfillment centers globally. In North America, there are more than 75 fulfillment centers, with plans to open more. Amazon has also developed new ideas and patents for technology that can be implemented in their fulfillment centers.

Warehouses as distribution centers have a complex system in how they operate, heavily influenced by online retailers. Most recently, there have been proposals to incorporate them into the urban environment. The development of this type of building within larger cities creates an opportunity for architects to become part of its design. Logistics has grown within the new technological advances and could be implemented in the urban environment.

This thesis takes Amazon patent drawings as a starting point to speculate about a future in which distribution centers take the typology of a skyscraper and become part of a city. The new fulfillment center will aim to bring public programs that will interact spatially with the different logistics of the company to create unique relations between them. People will be able to experience Amazon and its logistics apart from the computer and in a physical way. The vertical fulfillment center, as a city within a city, will become an icon of current times.

"A warehouse is not a treasure trove, but an ever-changing station in the flow of merchandise"

(Centers for Storage and Distribution, Friedemann Wild)



(Army Logistician, "Modeling the Wholesale Logistics Base" from the book The Rule of Logistics)

This thesis project looks at the projection of Amazon's patent drawings for vertical fulfillment centers and speculates on their design to evolve into a significant typology in the present day.

WHAT?

This thesis takes Amazon patent drawings as a starting point to speculate about a future in which distribution centers take the typology of a skyscraper and become part of a city. The new fulfillment center will aim to bring public programs that will interact spatially with the different logistics of the company to create unique relations between them. People will be able to experience Amazon and its logistics apart from the computer and in a physical way. The vertical fulfillment center, as a city within a city, will become an icon of current times.

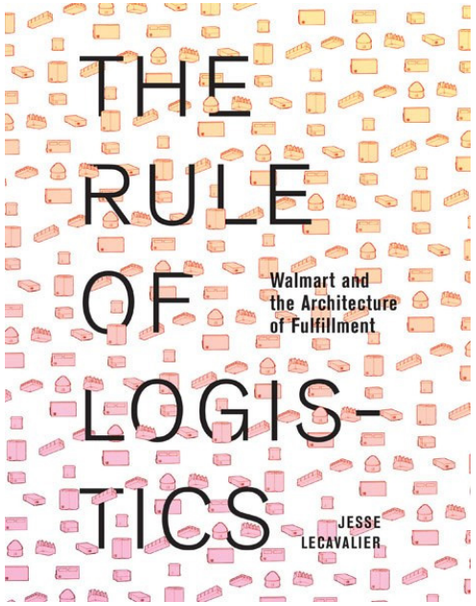
HOW?

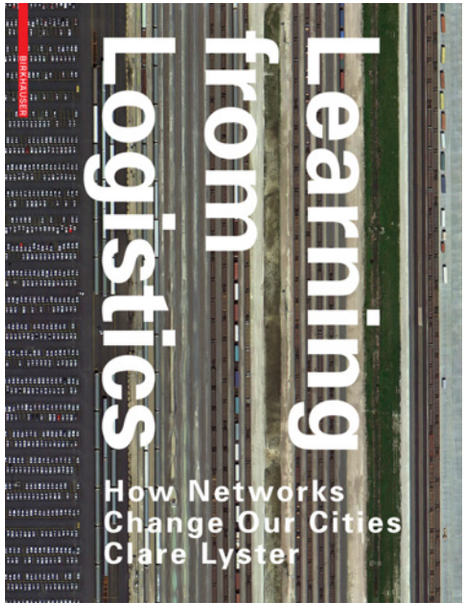
In June of 2017, Amazon released one of their most compelling patents, a multi-level fulfillment center with a beehive structure for Unmanned Aerial Vehicles. The release of drawings made international news. These could change the way distribution centers are perceived and designed. Amazon is the world's largest online retailer. In 2017, Amazon had 300 million users worldwide. Rapid growth has enabled Amazon to expand to different continents and forced them to open new fulfillment centers globally. In North America, there are more than 75 fulfillment centers, with plans to open more. Amazon has also developed new ideas and patents for technology that can be implemented in their fulfillment centers.

WHY?

Warehouses as distribution centers have a complex system in how they operate, heavily influenced by online retailers. Most recently, there have been proposals to incorporate them into the urban environment. The development of this type of building within larger cities creates an opportunity for architects to become part of its design. Logistics has grown within the new technological advances and could be implemented in the urban environment.

Two books used for main research and background were *The Rule of Logistics* by Jesse LeCavalier and *Learning from Logistics* from Clara Lyster. Both of their research focusing on the analysis and application of logistics in the urban environment.





amazon

today

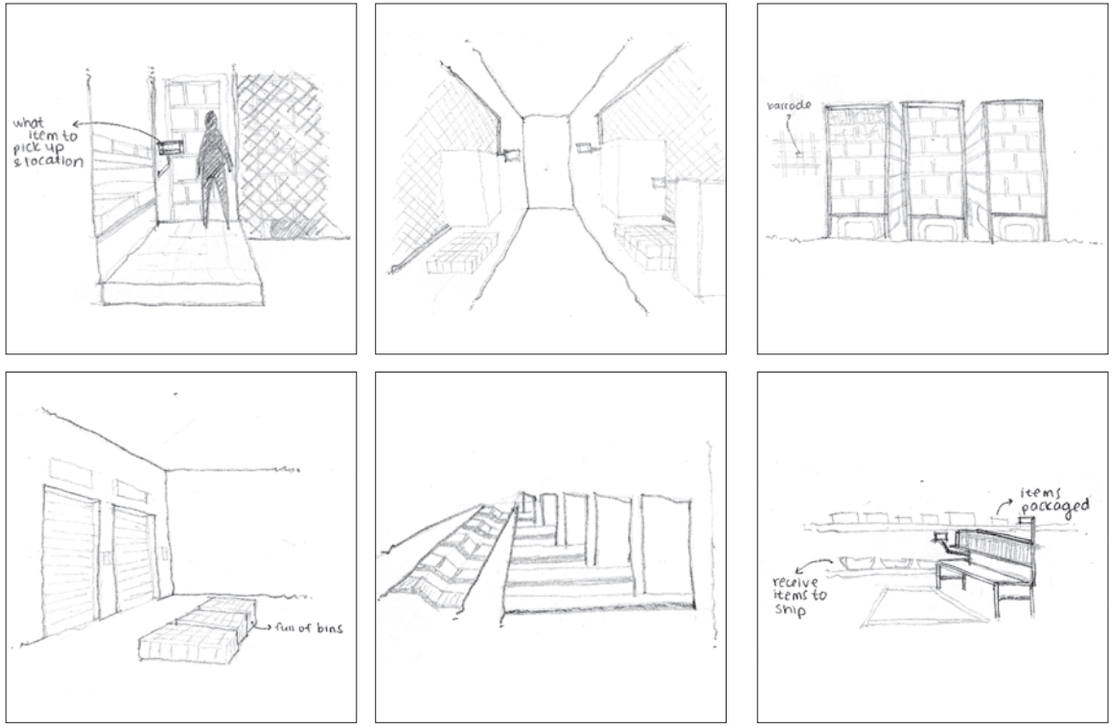
Amazon is the biggest online retailer making the biggest influence in logistics and distribution centers. They continually create patents with new technology and types of fulfillment centers.

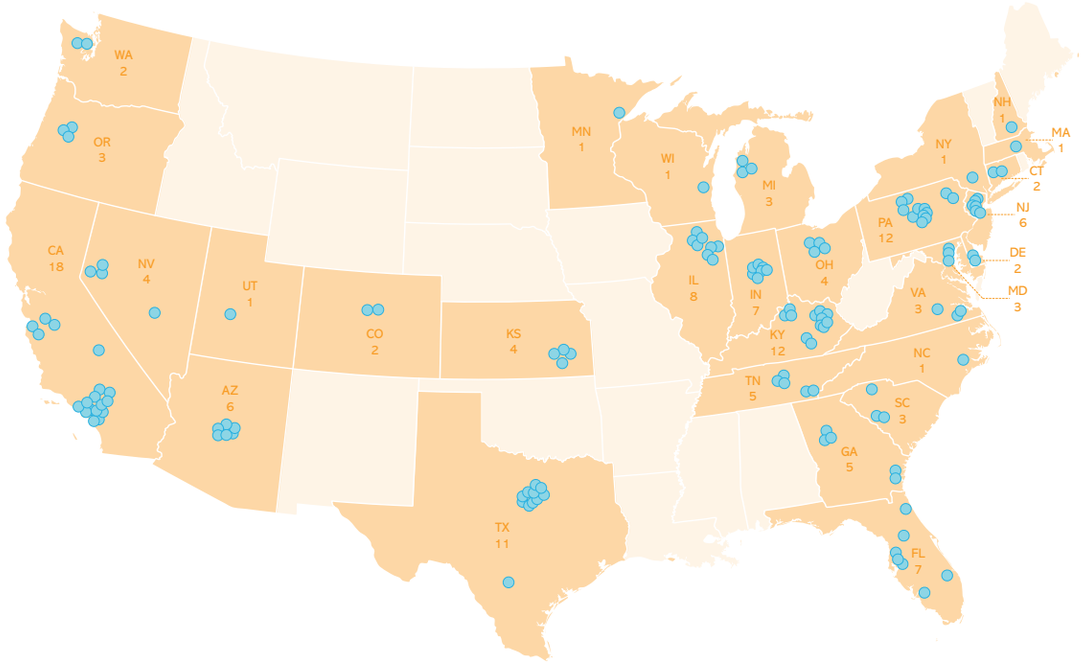
amazon fulfillment

Receiving and sorting area in warehouse in Leipzig, Germany

Library-style aisles in Amazon's warehouse in Phoenix

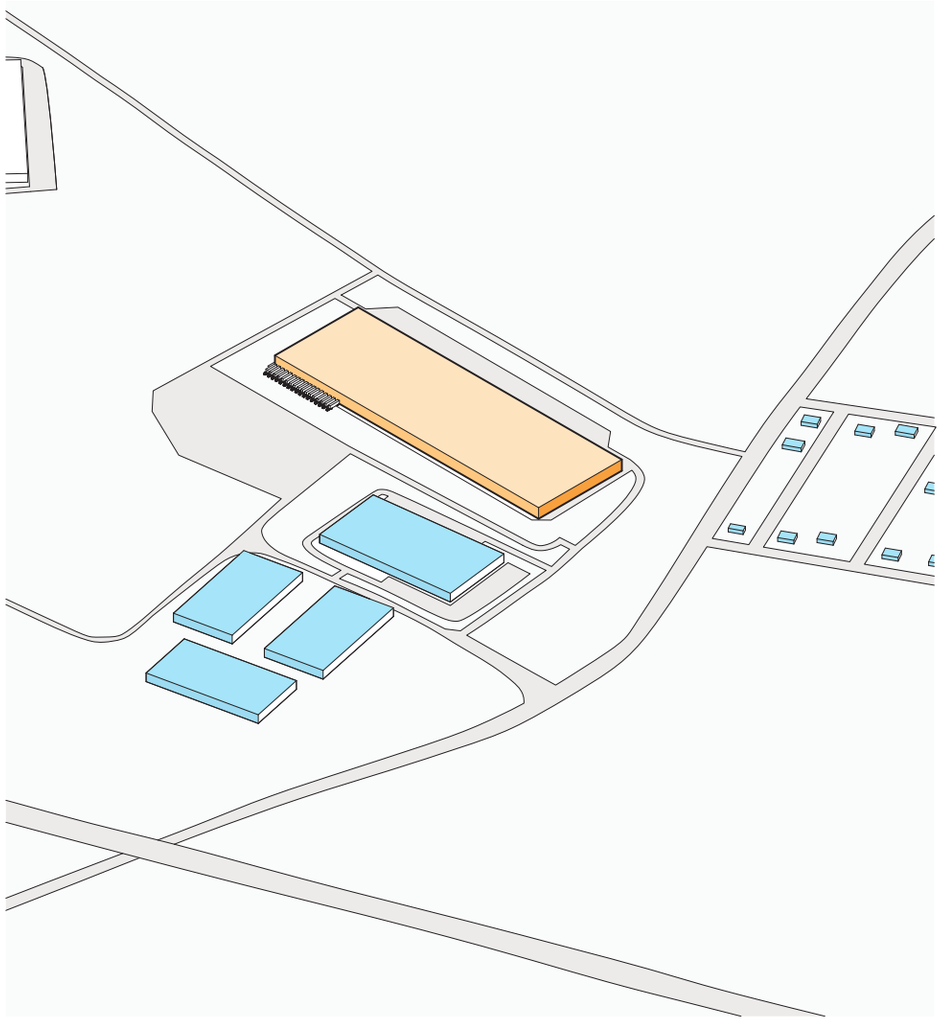
Packaging of products in warehouse in Peterborough, England



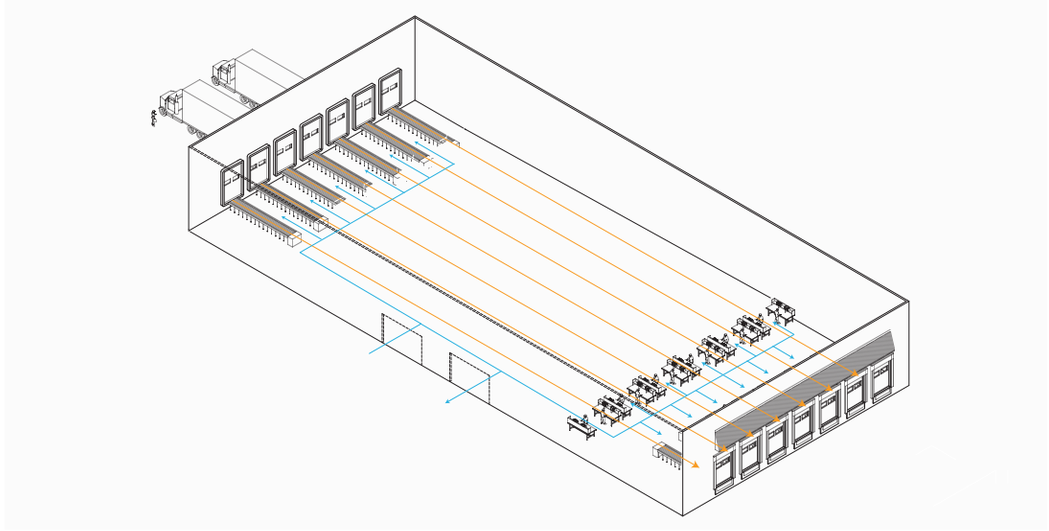


Amazon changes the name of distribution center to fulfillment center. Amazon expanded immensely in the last decade and that has lead to an increase of warehouses. In North America, there are more than 130 fulfillment centers, with plans to open more in the next years.

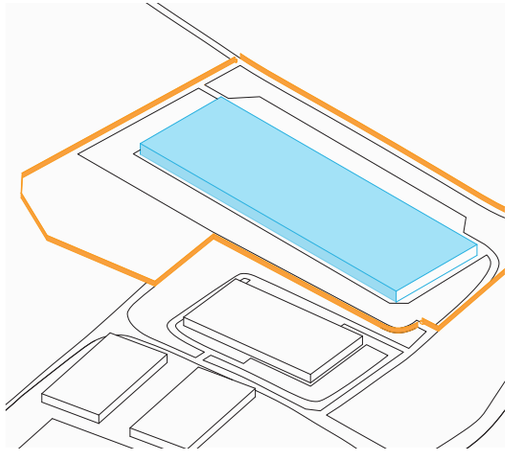
location



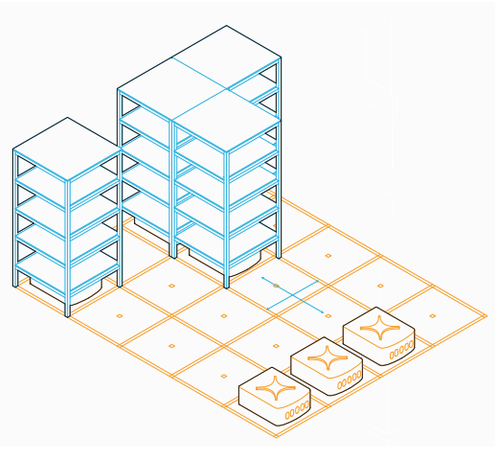
circulation



security

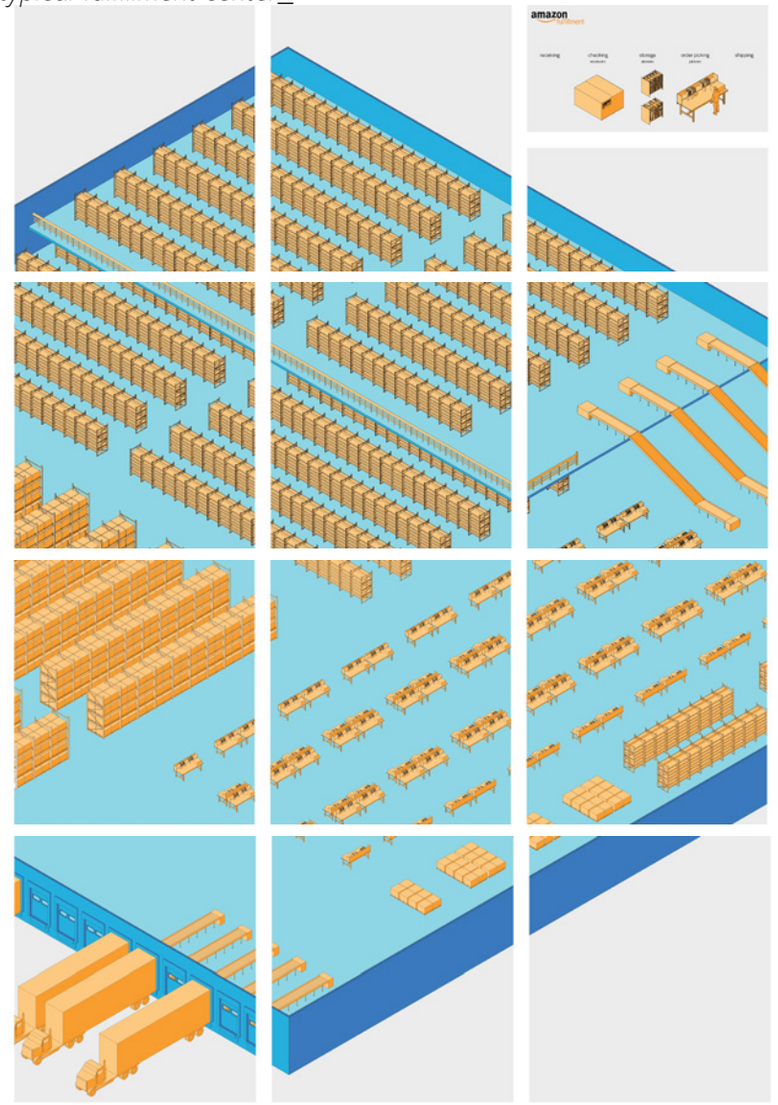


technology



Its logistics is divided in five stages. The receiving area, then stowing, the storage area, picking zone and finally shipping. Timing for a product to move through all these stages vary depending on public's demand and if it's holiday season.

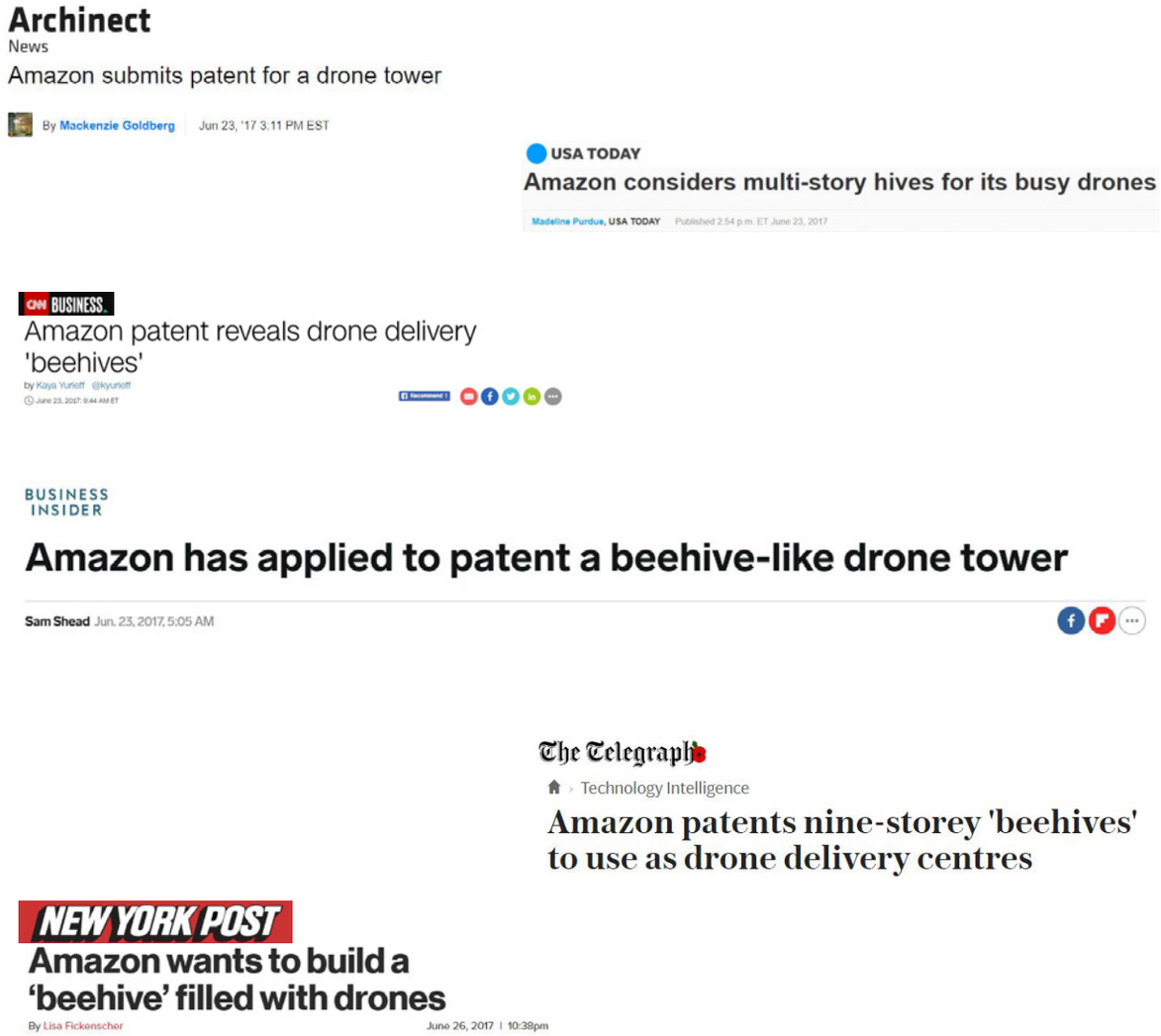
*_logistics of typical fulfillment center_*



future

of fulfillment centers

In June of 2017, Amazon released one of their most compelling patents, a multi-level fulfillment center with a beehive structure for Unmanned Aerial Vehicles. The release of drawings made international news.



US 20170175413A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2017/0175413 A1**

Curlander et al. (43) **Pub. Date: Jun. 22, 2017**

(54) **MULTI-LEVEL FULFILLMENT CENTER FOR UNMANNED AERIAL VEHICLES**

(71) Applicant: **Amazon Technologies, Inc.**, Seattle, WA (US)

(72) Inventors: **James Christopher Curlander**, Bellevue, WA (US); **Asaf Gilboa-Amir**, Seattle, WA (US); **Lauren Marie Kisser**, Seattle, WA (US); **Robert Arthur Koch**, Issaquah, WA (US); **Ricky Dean Welsh**, Bellevue, WA (US)

(21) Appl. No.: **14/975,618**

(22) Filed: **Dec. 18, 2015**

Publication Classification

(51) **Int. Cl.**

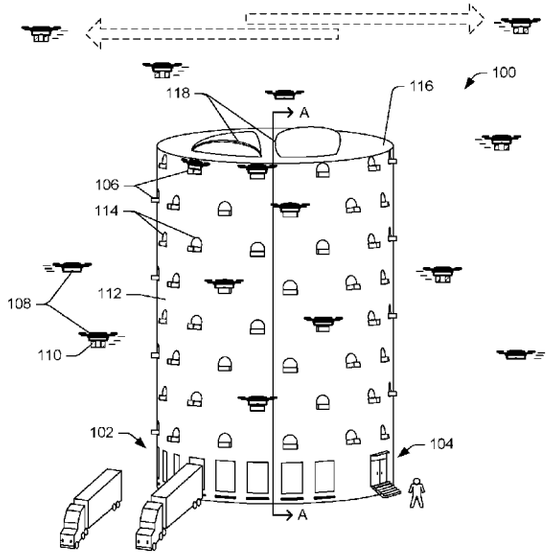
E04H 14/00	(2006.01)
B64C 39/02	(2006.01)
B64F 1/02	(2006.01)
B64F 1/32	(2006.01)
B64F 1/10	(2006.01)
B64F 1/36	(2006.01)

(52) **U.S. Cl.**

CPC ***E04H 14/00*** (2013.01); ***B64F 1/10*** (2013.01); ***B64F 1/362*** (2013.01); ***B64F 1/025*** (2013.01); ***B64F 1/32*** (2013.01); ***B64C 39/024*** (2013.01); *B64C 2201/128* (2013.01); *B64C 2201/20* (2013.01); *B64C 2201/18* (2013.01); *B64C 2201/066* (2013.01)

(57) **ABSTRACT**

A multi-level (ML) fulfillment center is designed to accommodate landing and takeoff of unmanned aerial vehicles (UAVs), possibly in an urban setting, such as in a densely populated area. Unlike traditional fulfillment centers, the ML fulfillment centers may include many levels (i.e., stories, floors, etc.) as permitted under zoning regulations for respective areas. The fulfillment center may have one or more landing locations and one or more deployment locations to accommodate UAVs, which may delivery at least some of the items from the fulfillment center to locations associated with customers.



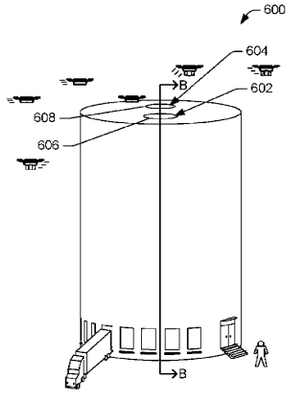
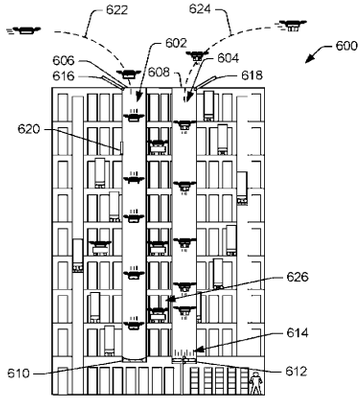
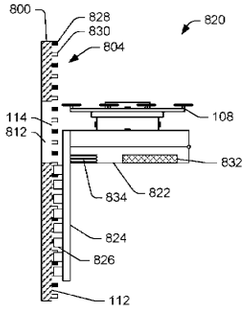


FIG. 6A



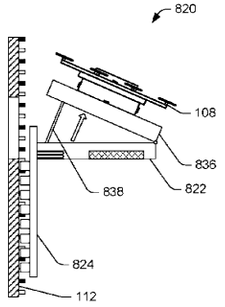
CROSS SECTION B-B

FIG. 6B



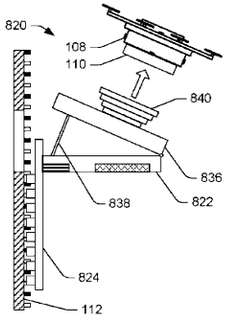
CROSS SECTION C-C

FIG. 8C



CROSS SECTION C-C

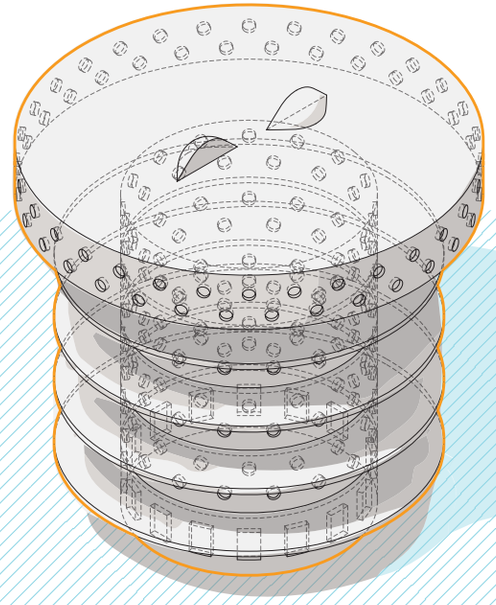
FIG. 8D



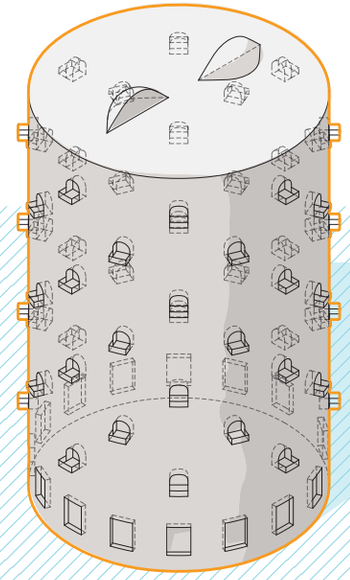
CROSS SECTION C-C

FIG. 8E

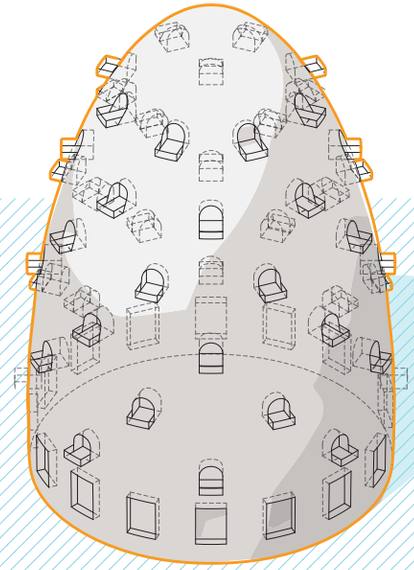
1



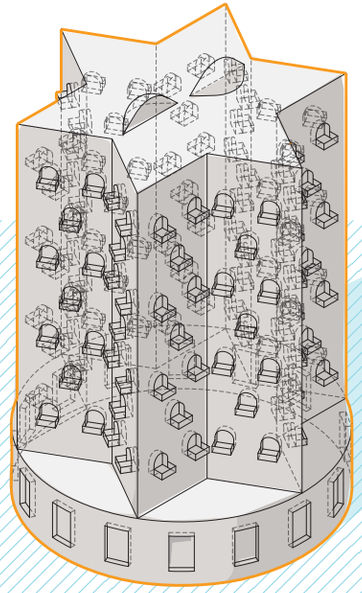
2



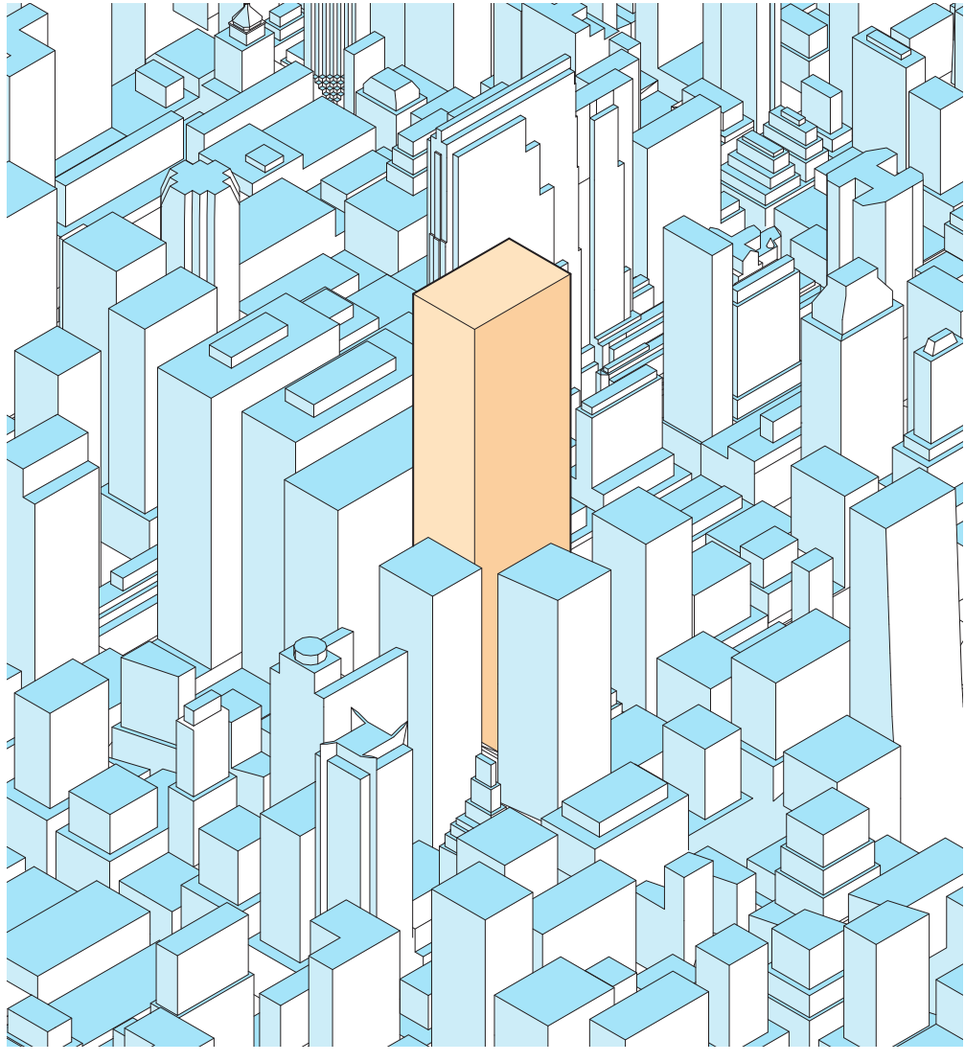
3



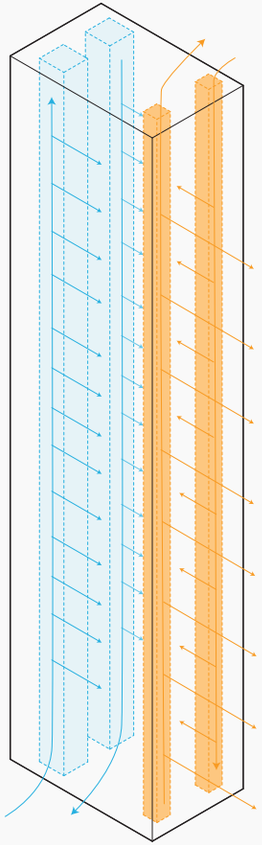
4



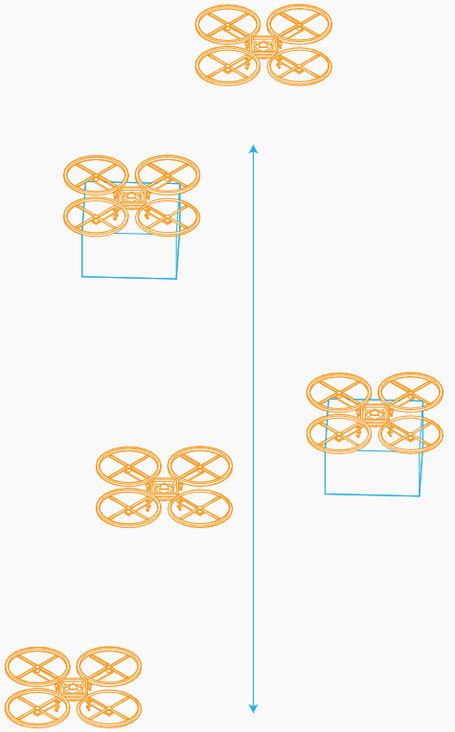
location



circulation

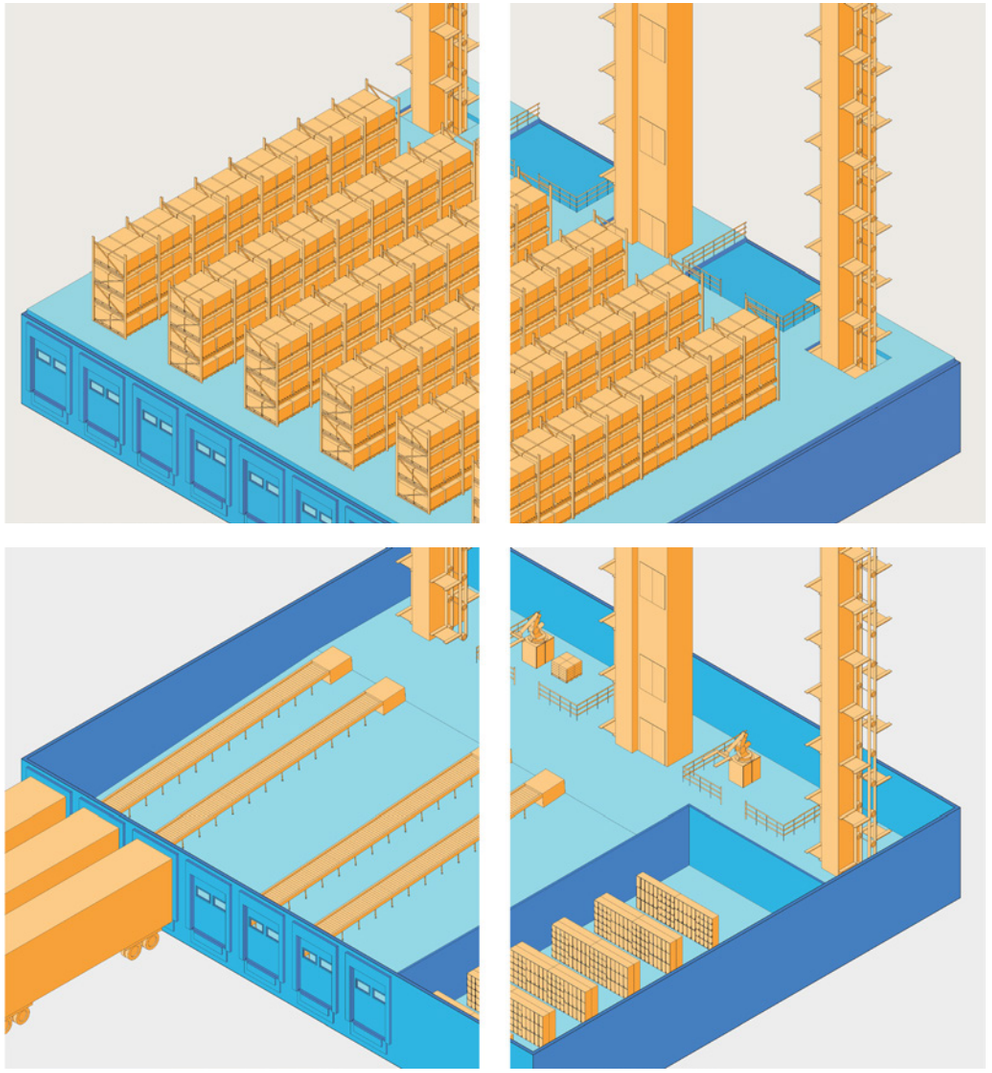


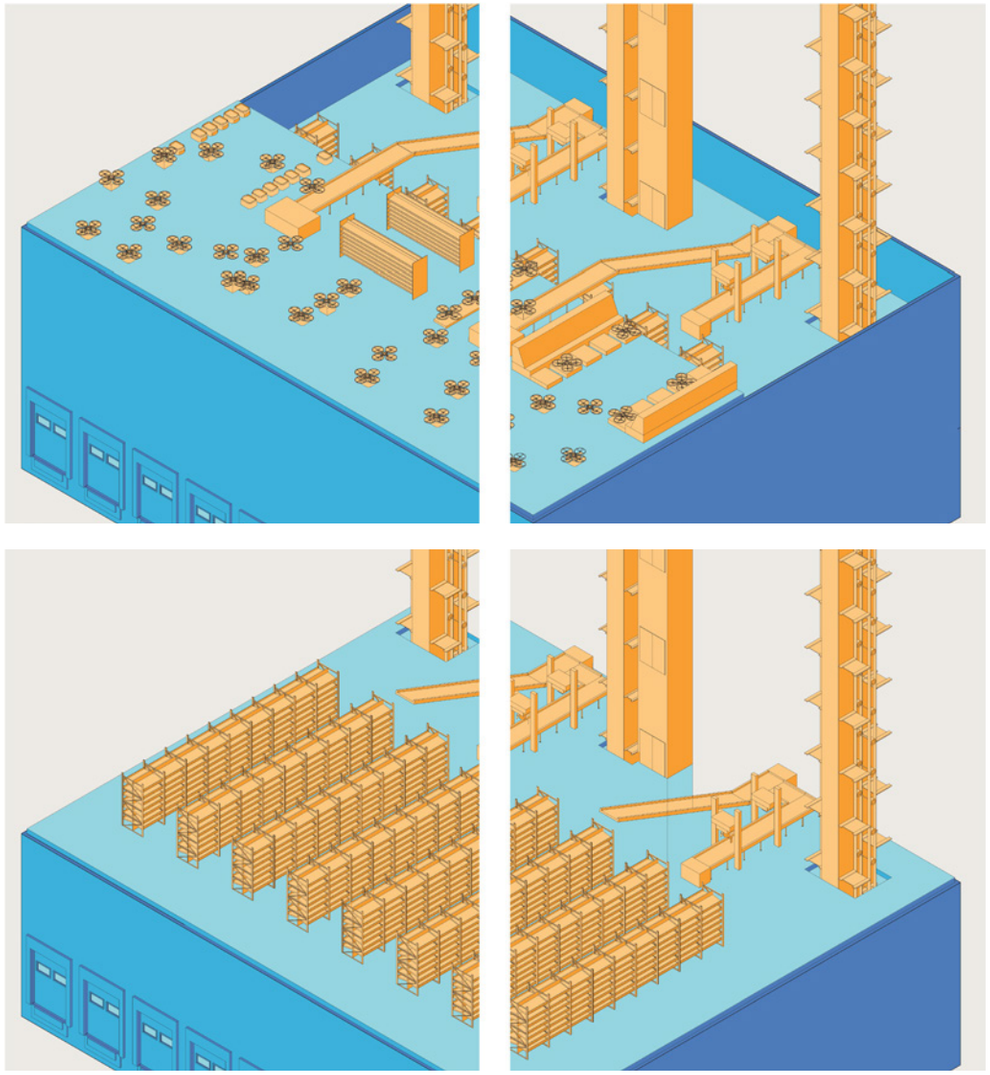
technology



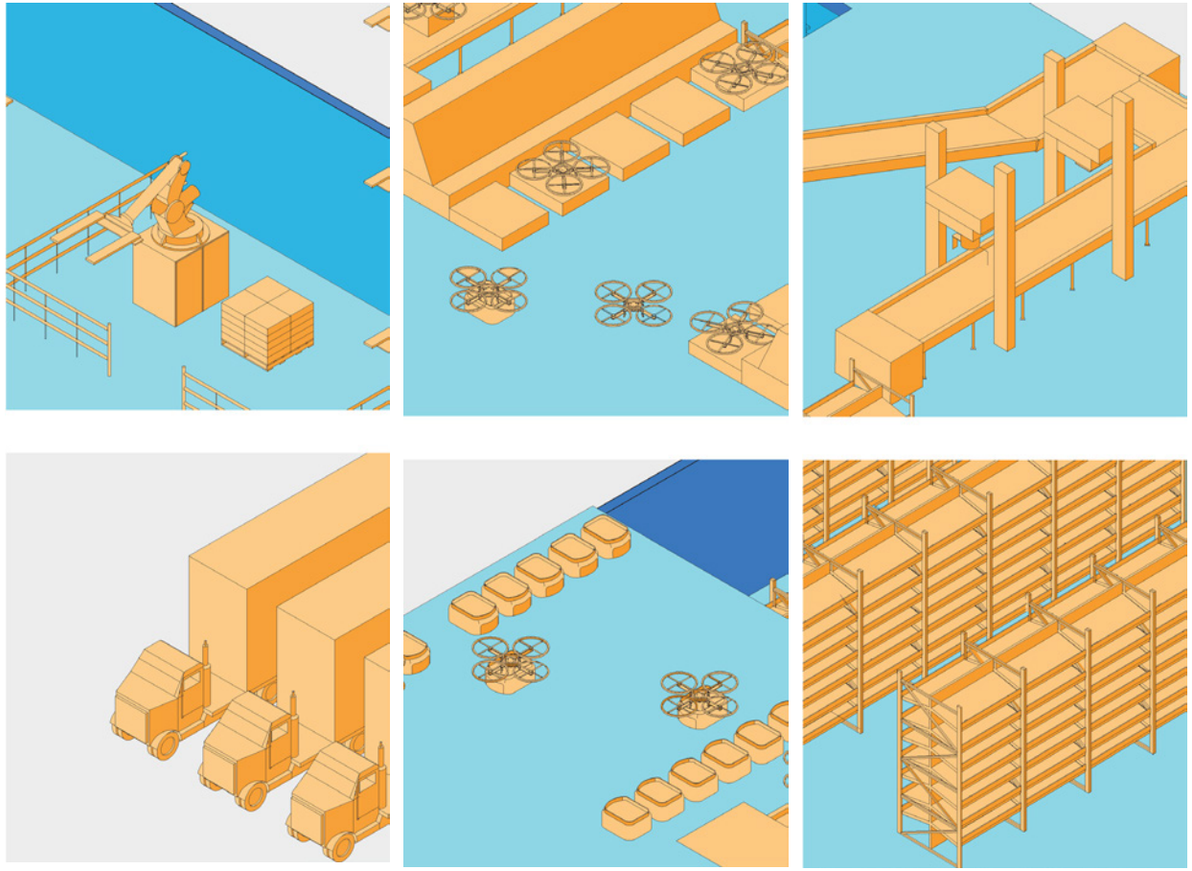
The patents have a detailed description of how these towers will operate. The logistics is similar to the typical fulfillment center. The first floor will be for the receiving area of the items and there will also be lockers for those costumers that want to pick up their orders. The first levels will be for the storage of big items. Levels in between will have medium size items and small items. A level specific for drones will be placed in between the storage levels.

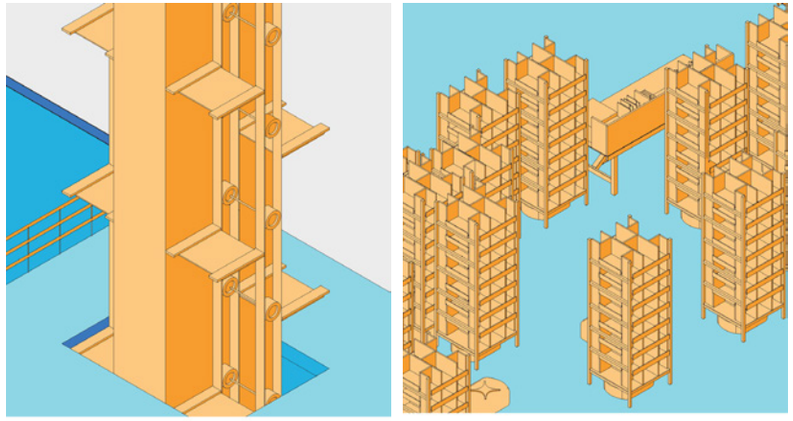
*_logistics of vertical fulfillment center_*





zoom ins





The levels **120** may include storage locations **122**, such as bins, racks, or other fixed or mobile devices for placing, at least temporarily, items to be delivered

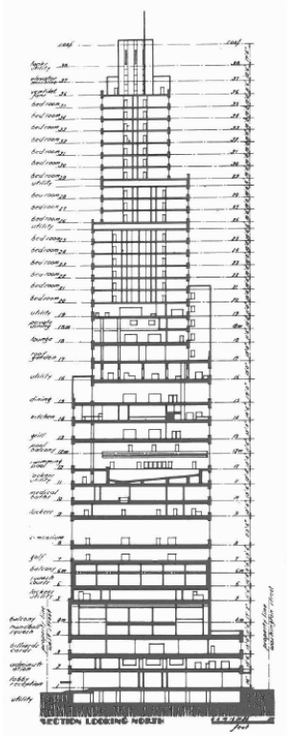
tions for respective areas. The fulfillment center may have one or more landing locations and one or more deployment locations to accommodate UAVs, which may delivery at

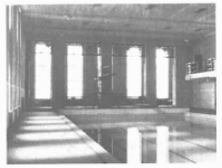
The robots may include item transport robots **124**(**1**), UAV transport robots **124**(**2**), and elevator robots **124**(M).

delivery. The ML fulfillment center may include services to charge batteries of the UAVs, inspect and/or service the UAVs, and/or perform other operations for the UAVs

new

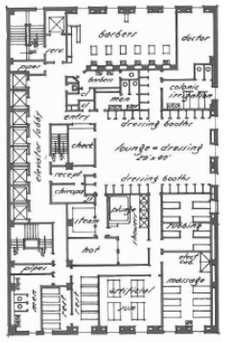
amazon



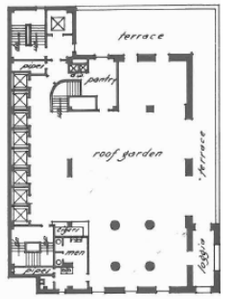


Downtown Athletic Club, 12th floor: swimming pool at night.

Downtown Athletic Club, seventh floor: interior golf course.



Downtown Athletic Club, plan of tenth floor.



Downtown Athletic Club, plan of 17th floor: interior roof garden with metropolitan verandas.

"...A MACHINE TO GENERATE AND INTENSIFY **DESIRABLE FORMS OF HUMAN INTERCOURSE...**"

"Definitive Instability: The Downtown Athletic Club" from Delirious New York, Rem Koolhaas

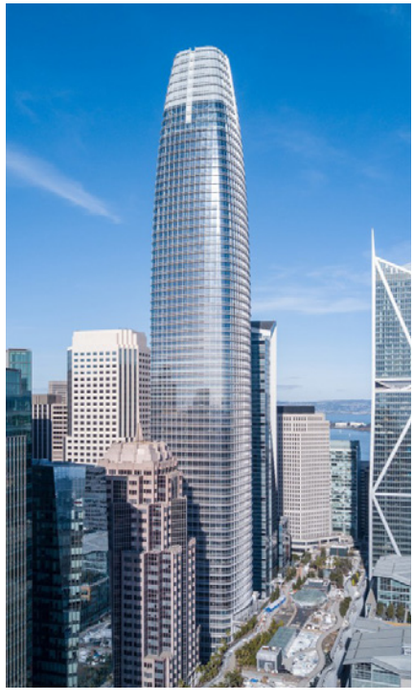
Since the new Amazon fulfillment center will be designed in the typology of the skyscraper, four different skyscrapers were chosen to be analyzed. The cities and skyscrapers were chosen based on the cities where Amazon has the most influence today.

The Independent

Austin, TX
Rhode Partners
Construction started: 2016
Estimated completion: 2019

Residential and commercial

Salesforce Tower



San Francisco, CA
Pelli Clarke Pelli Architects
Construction started: 2013
Estimated completion: 2018

Offices, commercial, connection to transportation hub

Vista Tower

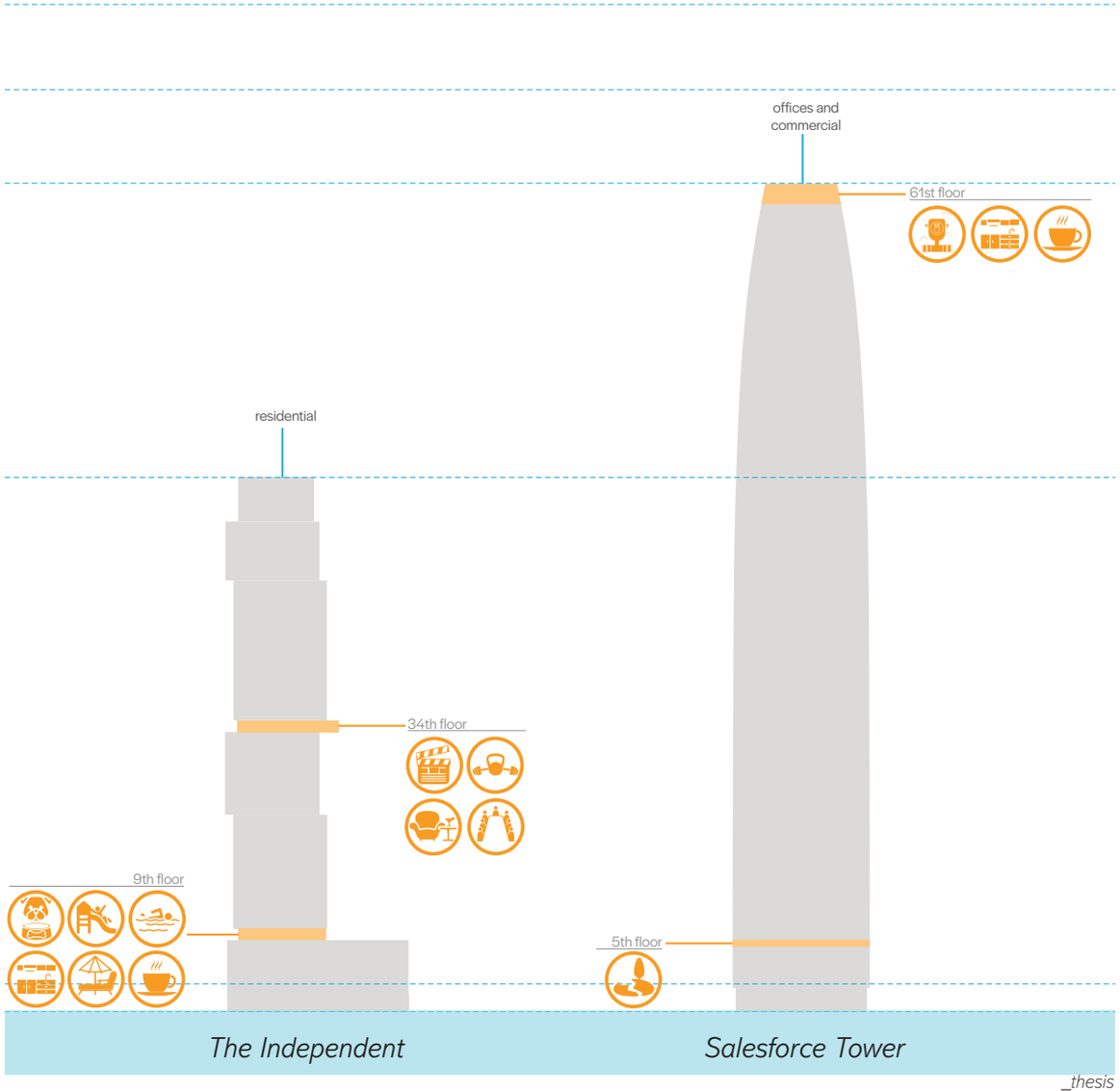
Chicago, Il
Studio Gang
Construction started: 2016
Estimated completion: 2020

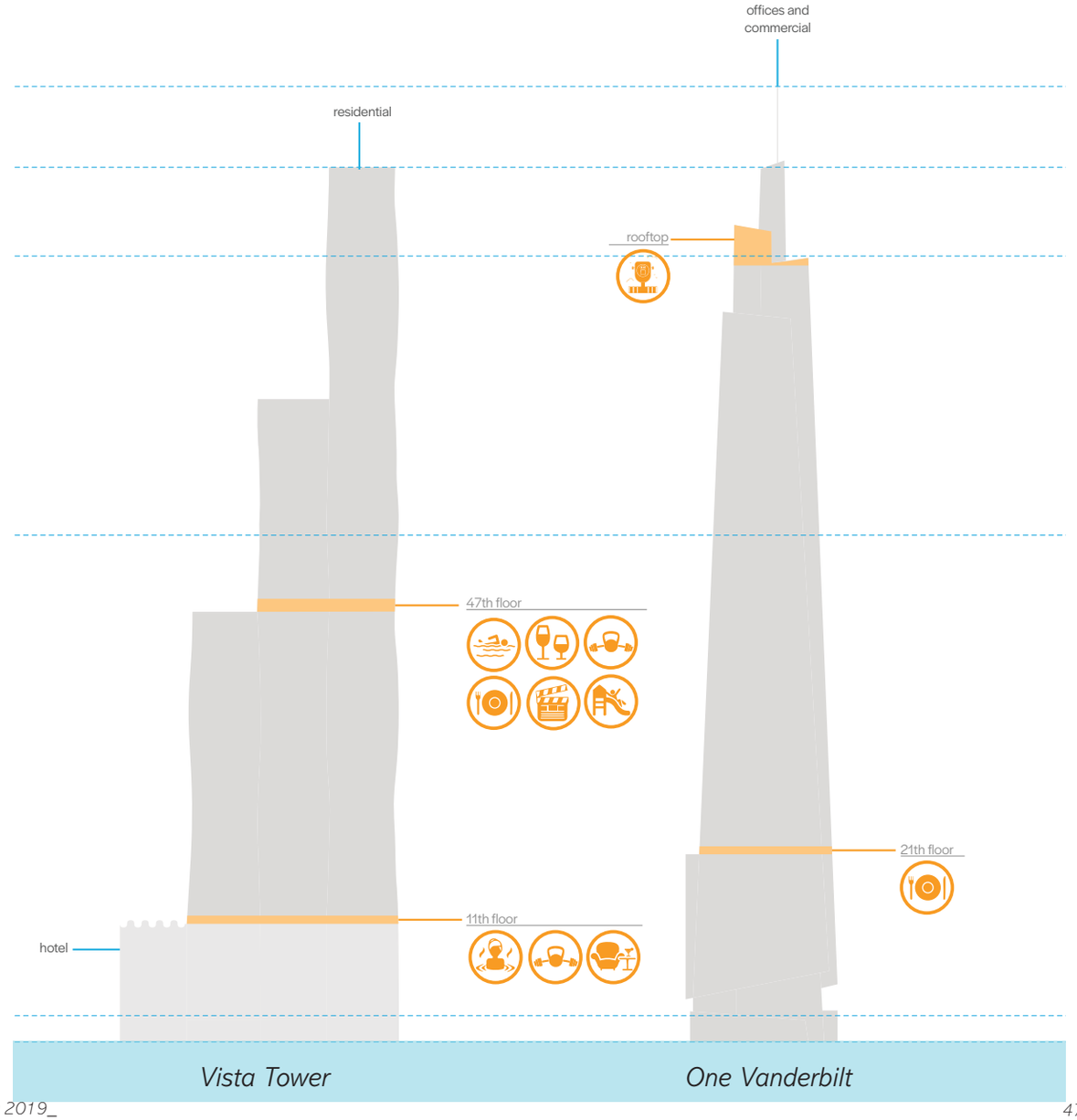
Residential, hotel, offices and commercial

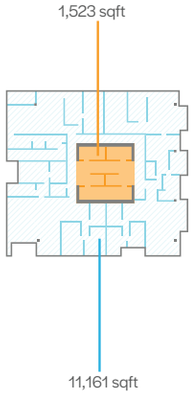
One Vanderbilt

New York, NY
KPF
Construction started: 2016
Estimated completion: 2020

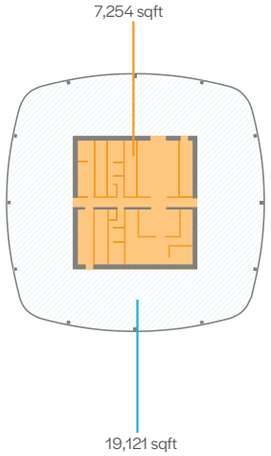
Offices, observation deck, commercial


offices and commercial
61st floor
residential
34th floor
9th floor
5th floor
The Independent
Salesforce Tower

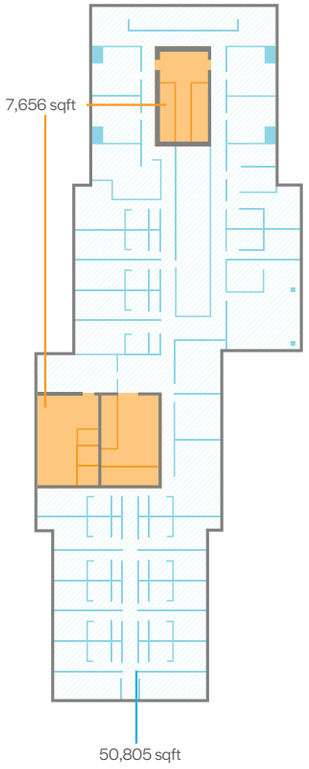

offices and commercial
residential
rooftop
47th floor
21th floor
11th floor
hotel
Vista Tower
One Vanderbilt



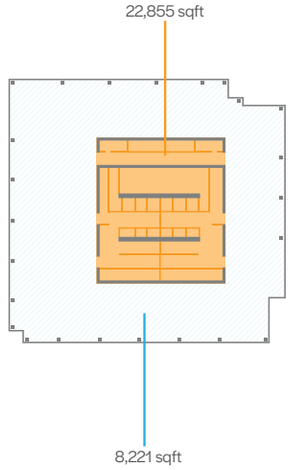
The Independent



Salesforce Tower



Vista Tower



One Vanderbilt

amazon city

fulfillment + xperience living visit

city within a city

Amazon Vertical City will have two components. The first one being the fulfillment center and public programs. Distribution centers are usually closed to the public.
This new fulfillment center will become a vertical city which will be situated in a larger city. The vertical fulfillment center, as a city within a city, will become an icon of current times.

primary membership

prime

add-ons to primary membership

prime student
Prime benefits +
50% off prime membership
Special deals for students

amazonfamily
Prime benefits +
Newsleter with parenting tips
20% off baby products
15% off baby registry discount

amazonsmile
0.5% of the price goes to charitable organization

benefits

shipping
Free two-day shipping
Same day shipping
Prime now (2-hour delivery)

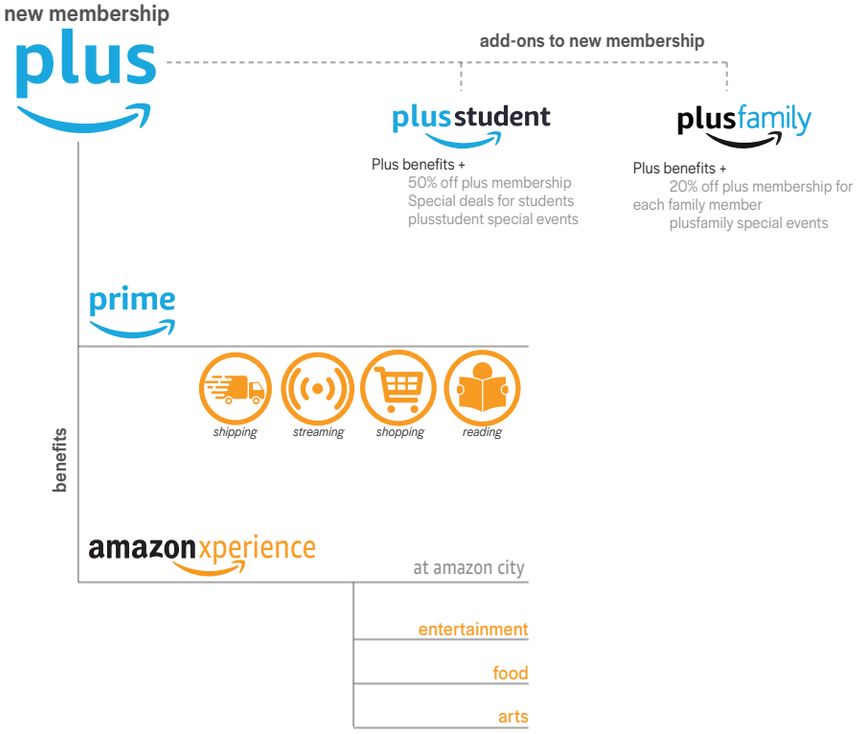
streaming
amazon music
prime video

shopping
amazon dash
prime wardrobe
fresh
PrimePantry
WHOLE FOODS

reading
prime reading
audible

additional services
(without prime subscription)

amazon go
amazon books
amazonlocker
amazon POP-UP
amazon 4-star


new membership
plus
add-ons to new membership
plusstudent
Plus benefits +
50% off plus membership
Special deals for students
plusstudent special events
plusfamily
Plus benefits +
20% off plus membership for each family member
plusfamily special events
prime
benefits
shipping
streaming
shopping
reading
amazonxperience
at amazon city
entertainment
food
arts


additional services
(without plus subscription)
new
amazonliving
amazonvisit
amazonlocker
amazon POP-UP
amazon 4-star


amazonxperience
new amazon programs
entertainment
food
arts
bowling
golf range
food market
wine bar
museum
sculptural garden
rock climbing
pool
cooking classes
dining
theater
restoration
game center
playroom
greenhouses
barista bar
art gallery
art classes

amazonliving

long term and short term rentals

amenities

bedroom/studio

kitchen

wifi

alexa

washer/dryer

pets allowed

amazonvisit

educational program

activities

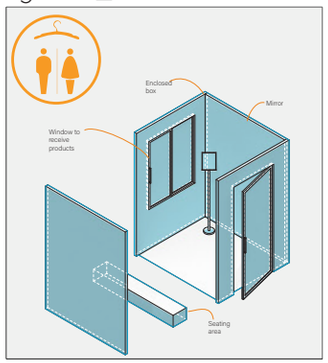
fulfillment center

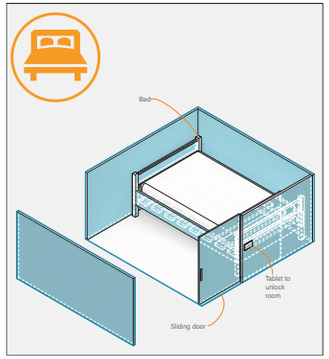
drone delivery

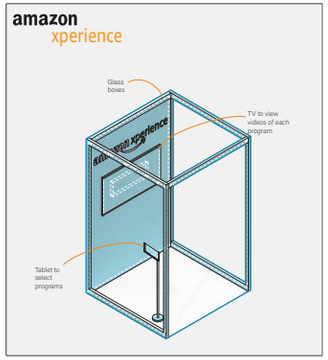
amazon xperience

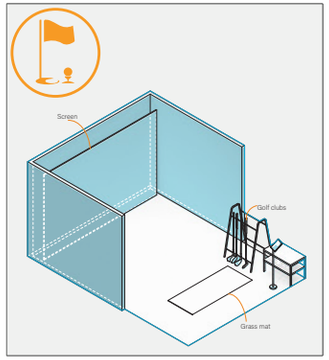
The design of the Amazon tower is divided in two key components. First, the serial production of the programs and then the core and façade design.

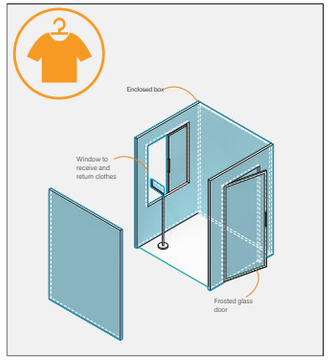
Axon of public programs

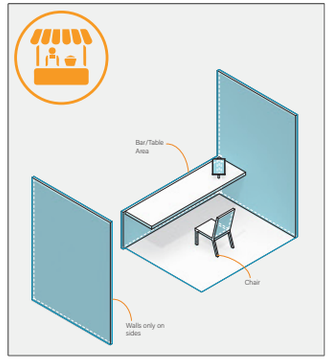


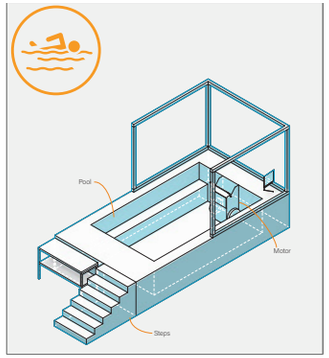


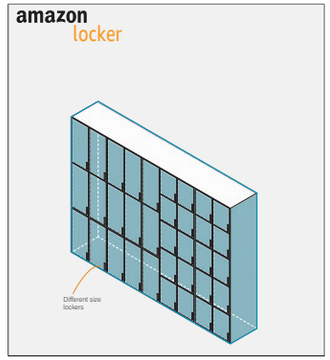


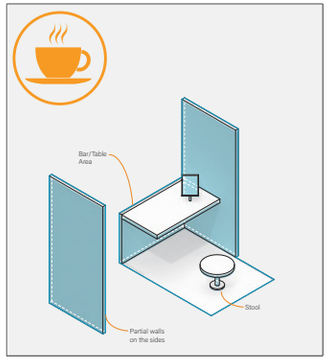


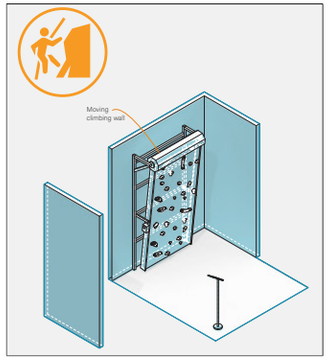




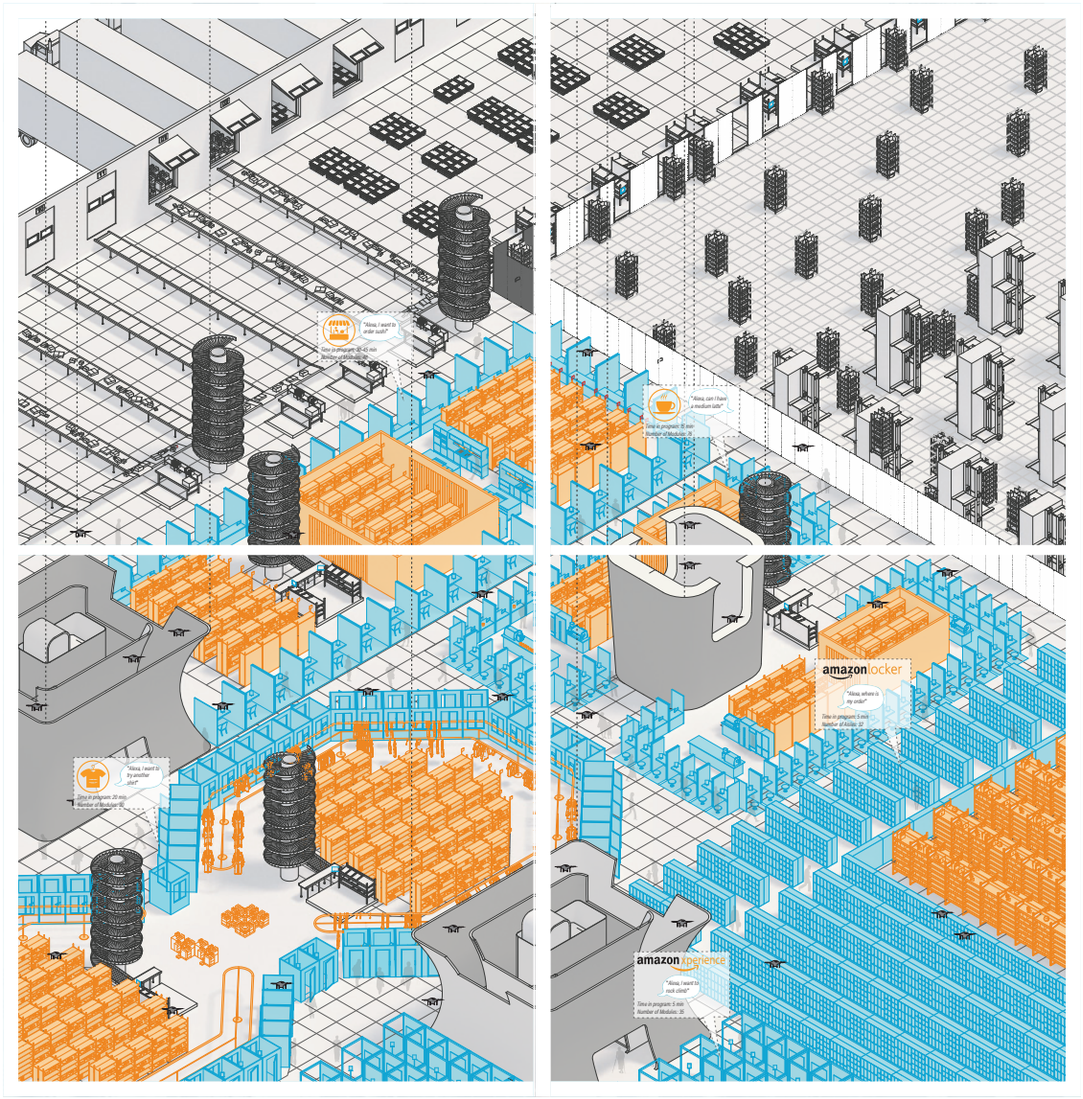




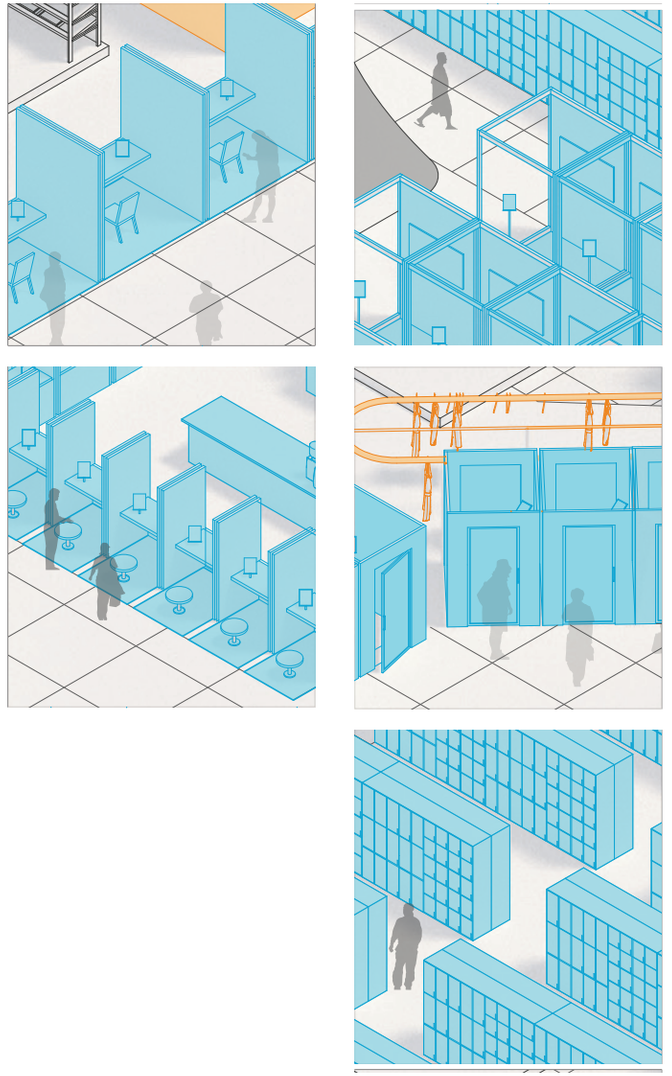




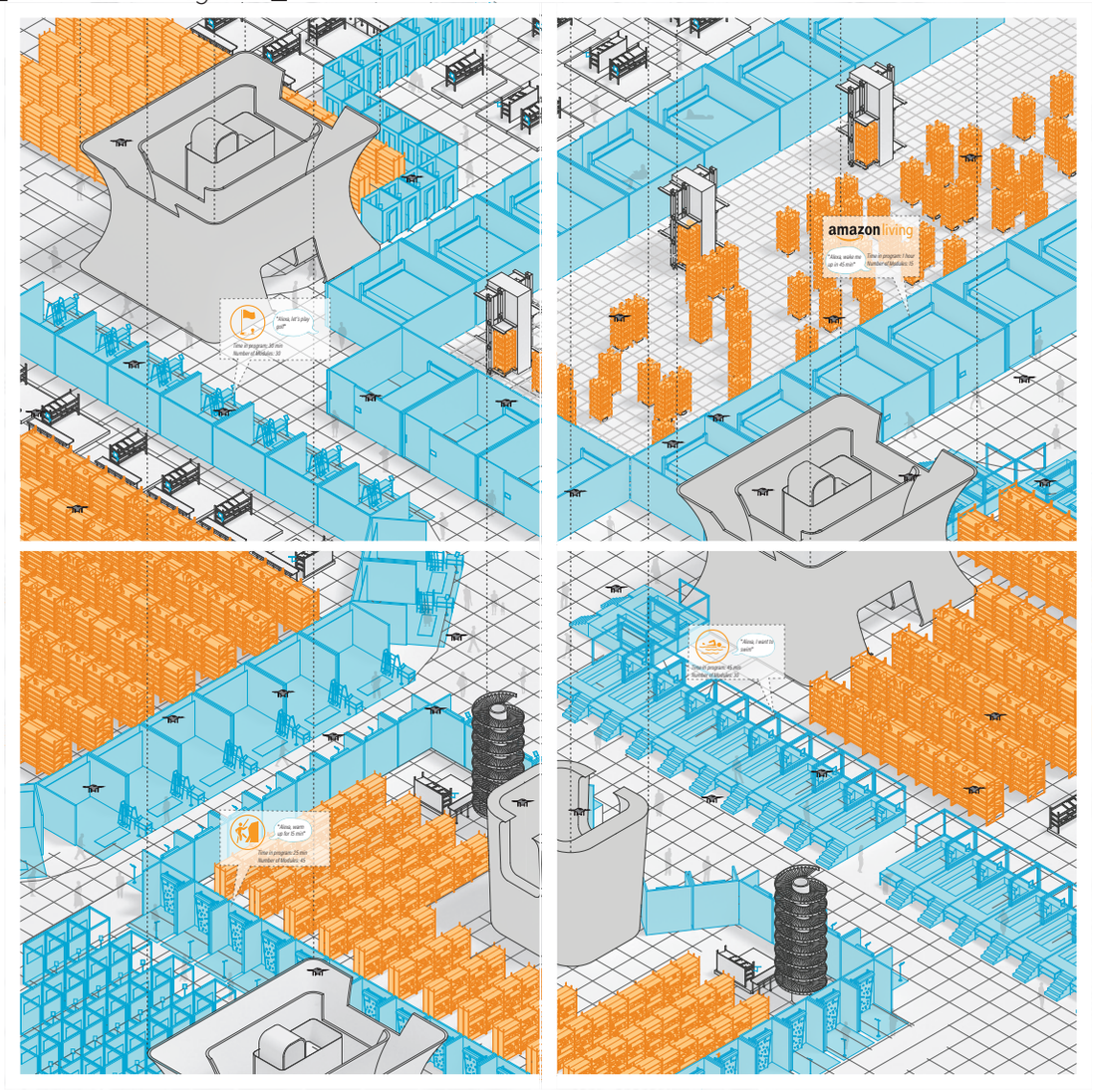
FC + Public Programs



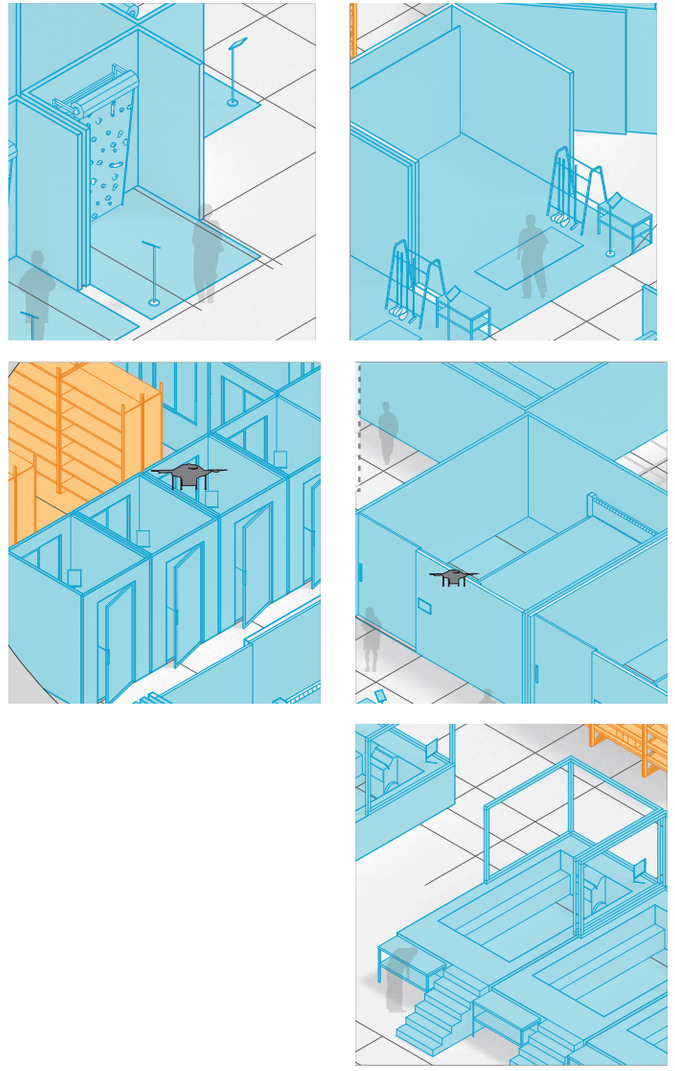
Zoom ins of public programs



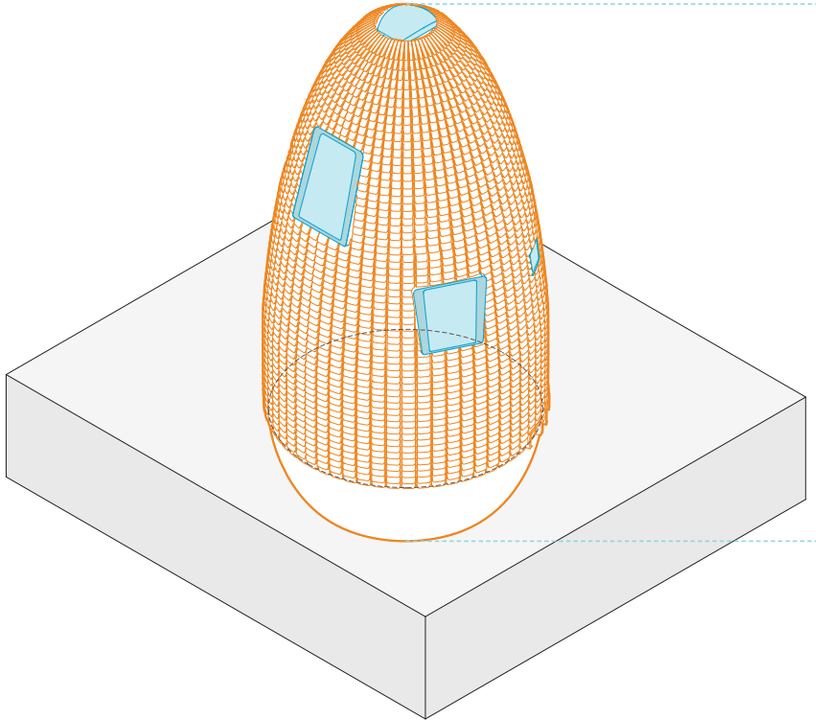
FC + Public Programs



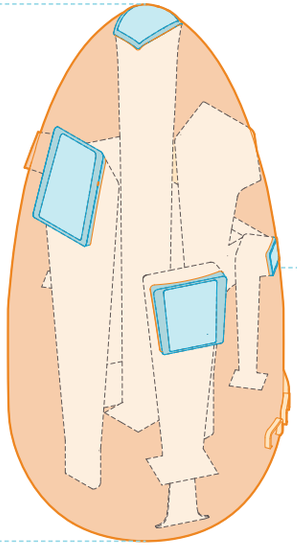
Zoom ins of public programs



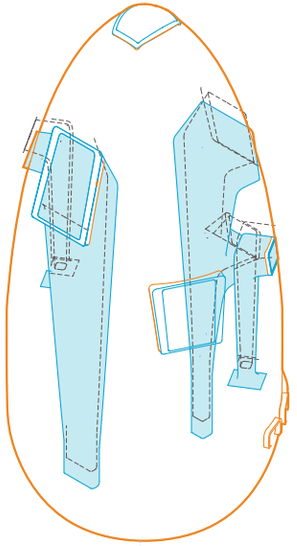
*_Mass vs. core diagrams_*



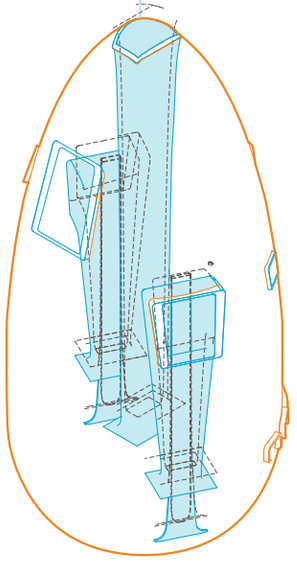
Exterior mass



Cores

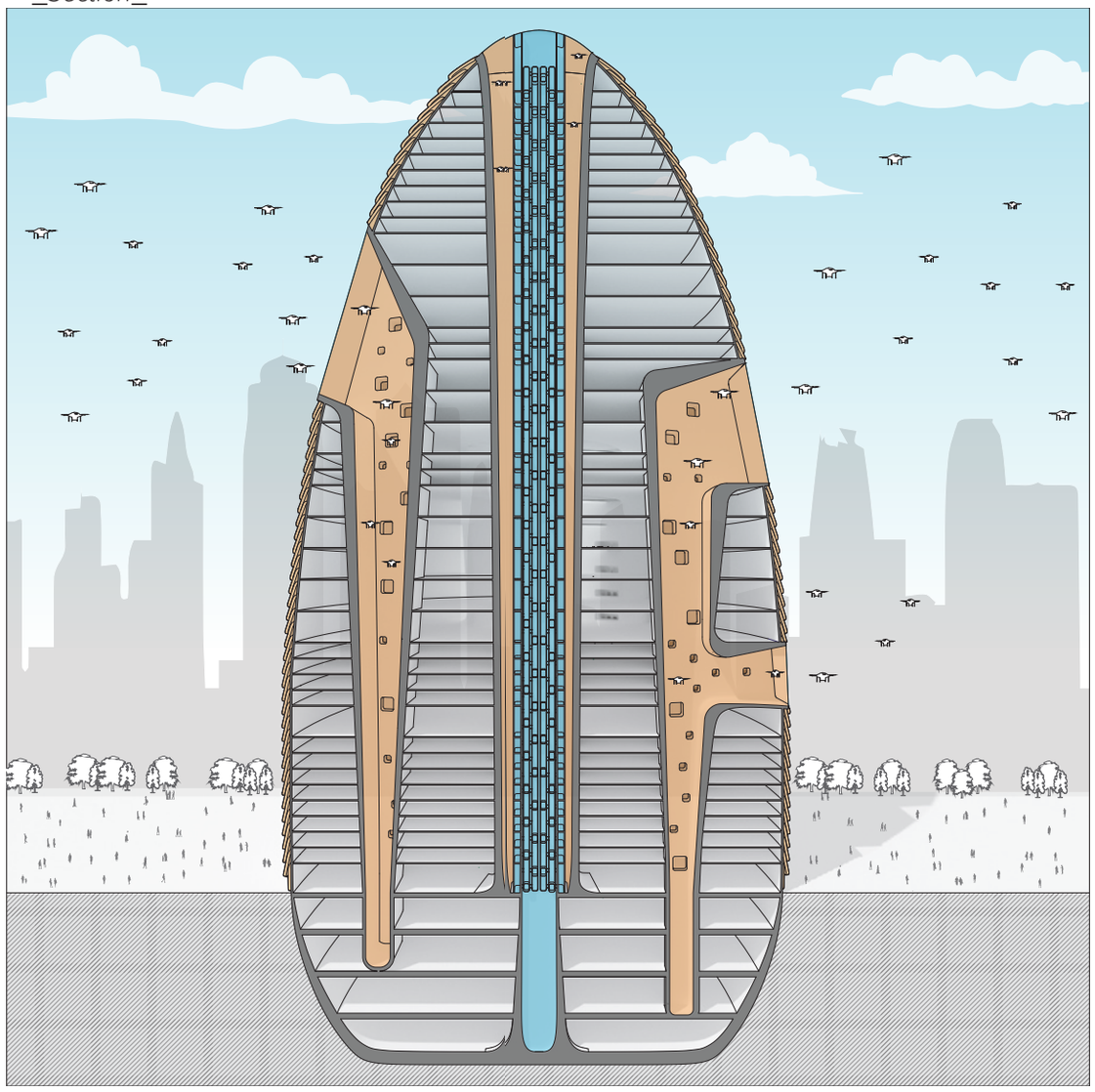


Drones
cores

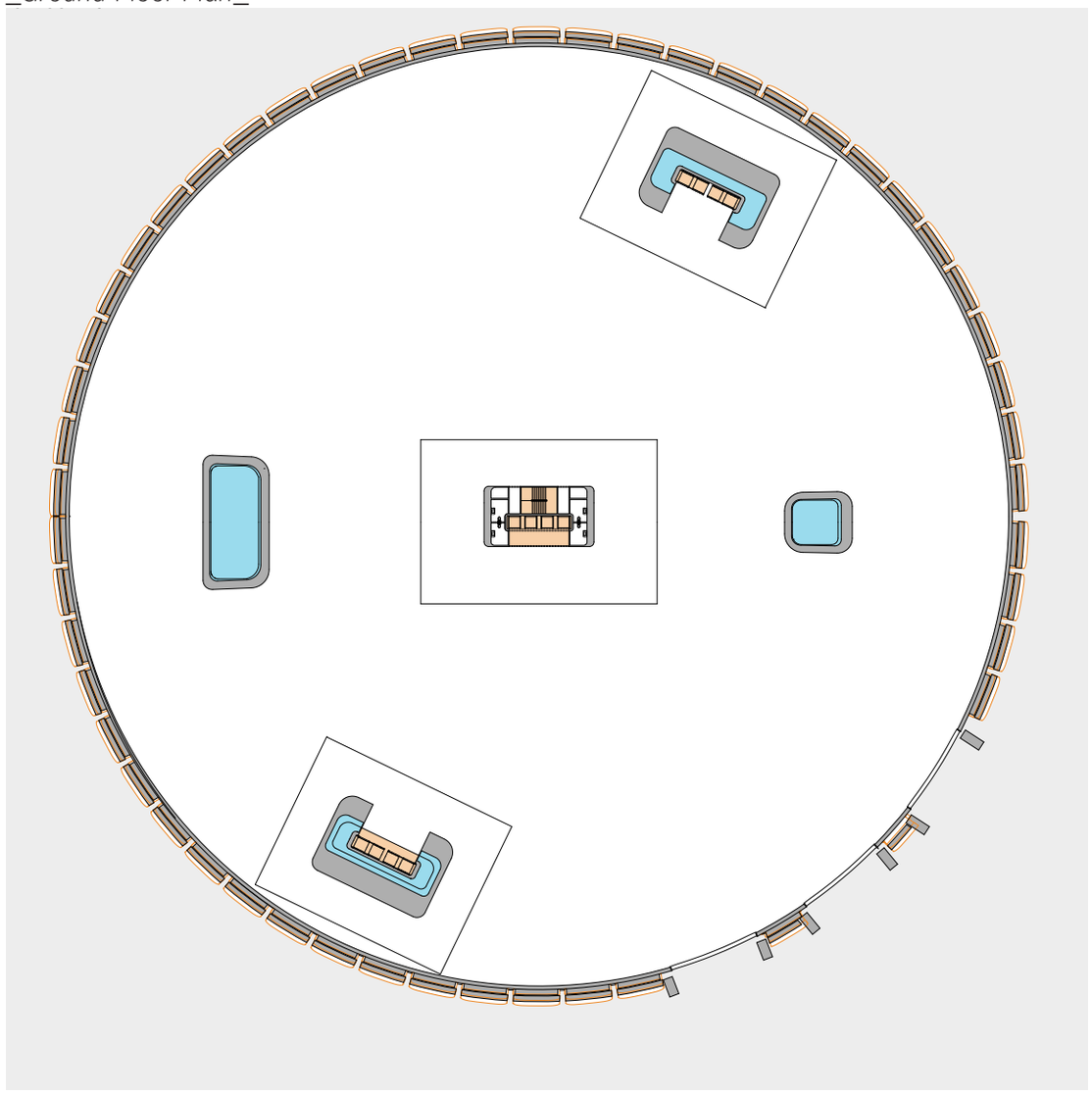


People
+
Drones
cores

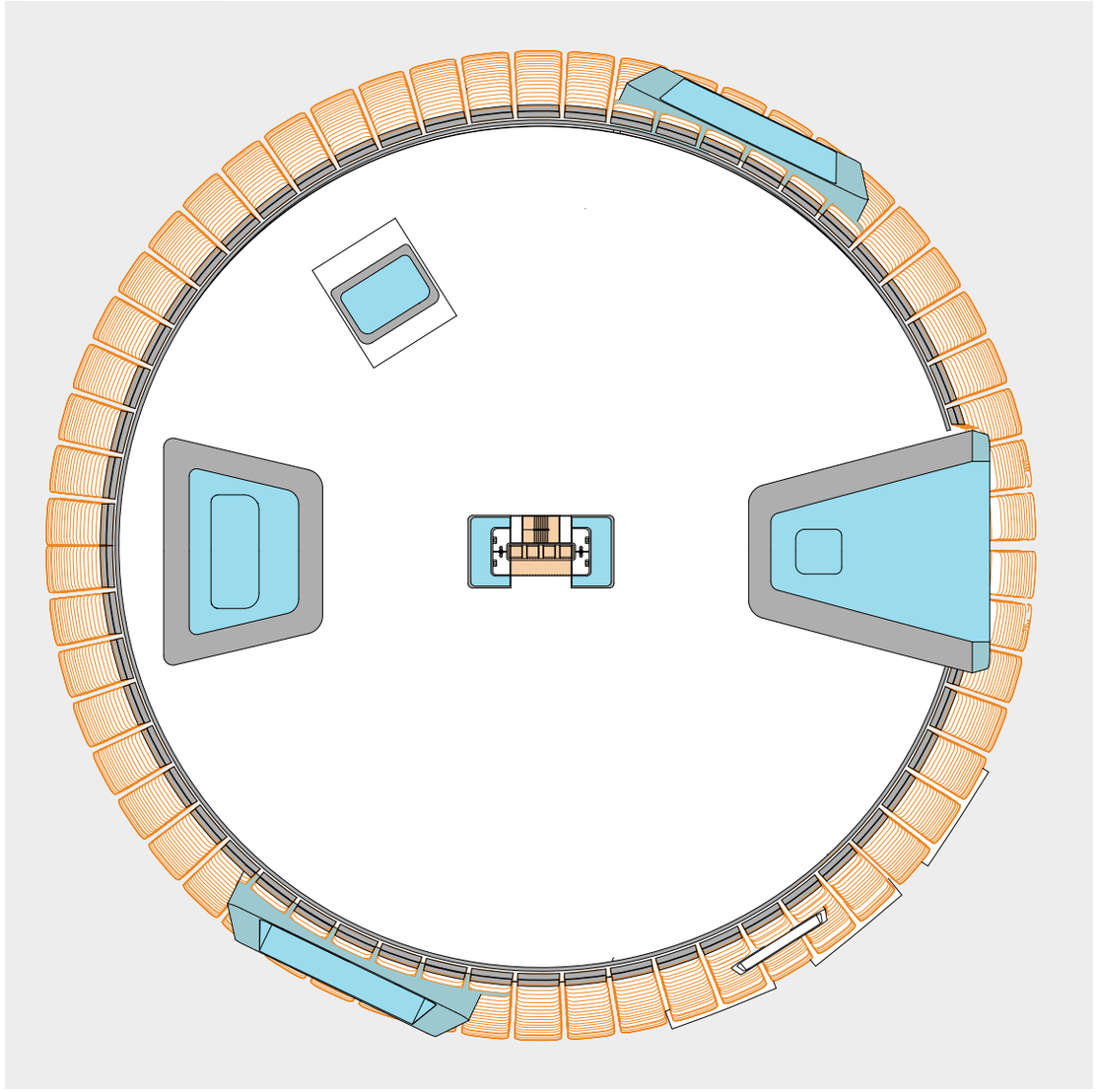
Section



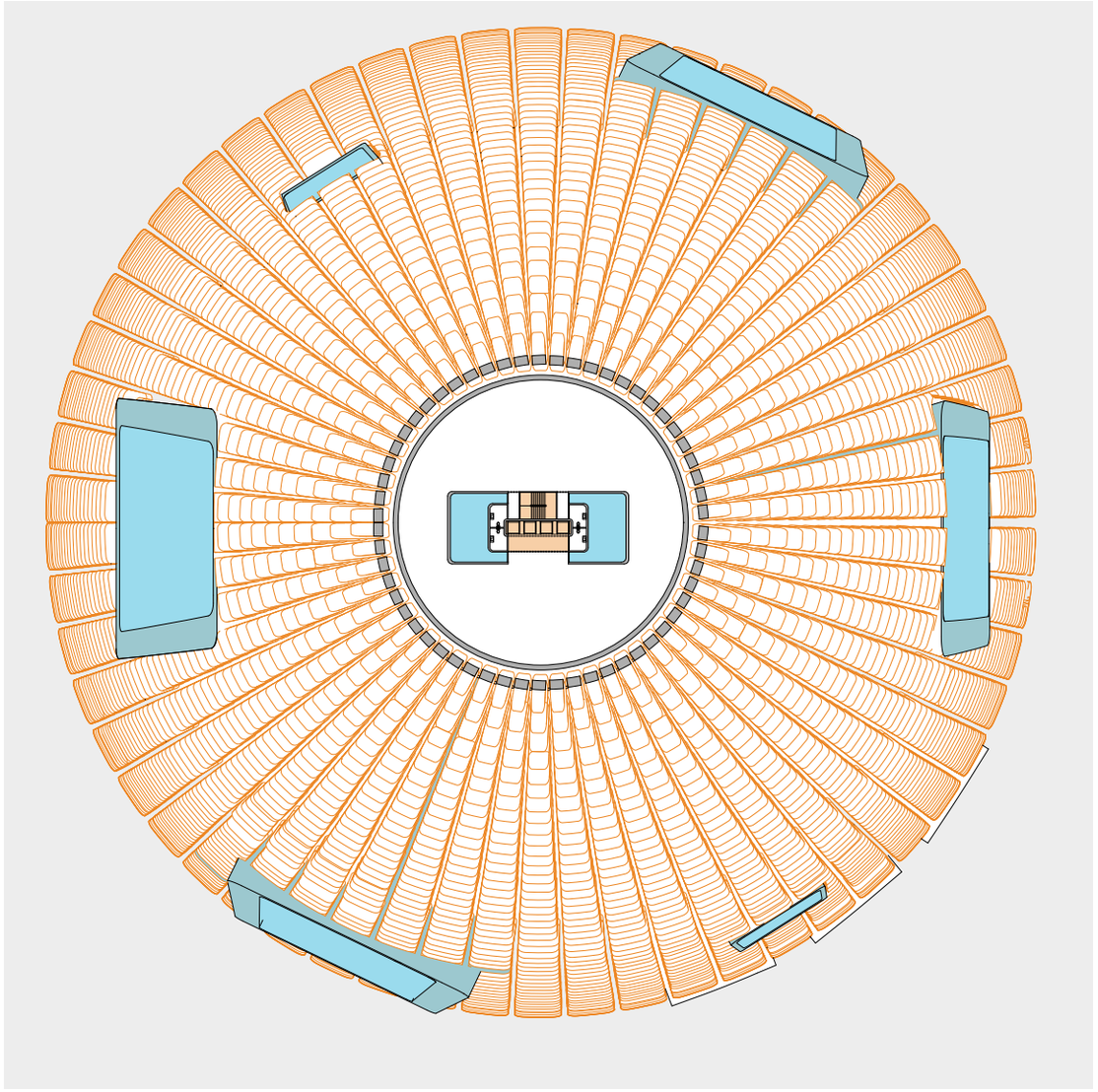
Ground Floor Plan



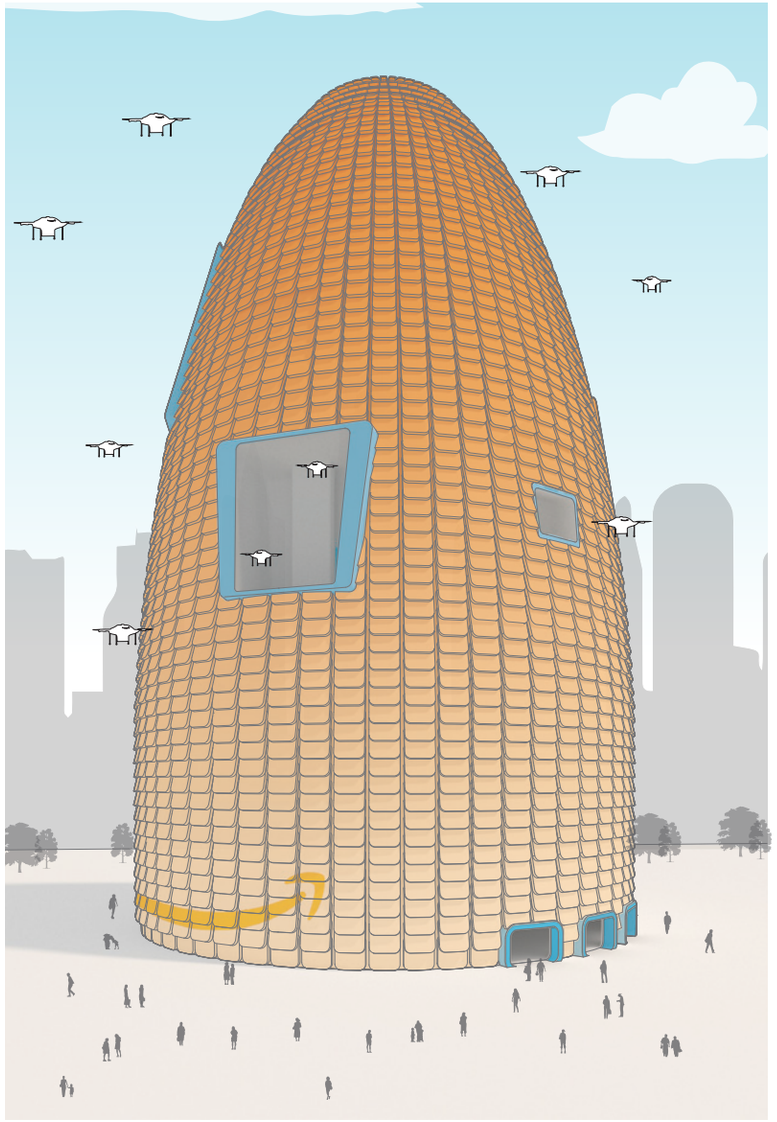
20th Floor Plan

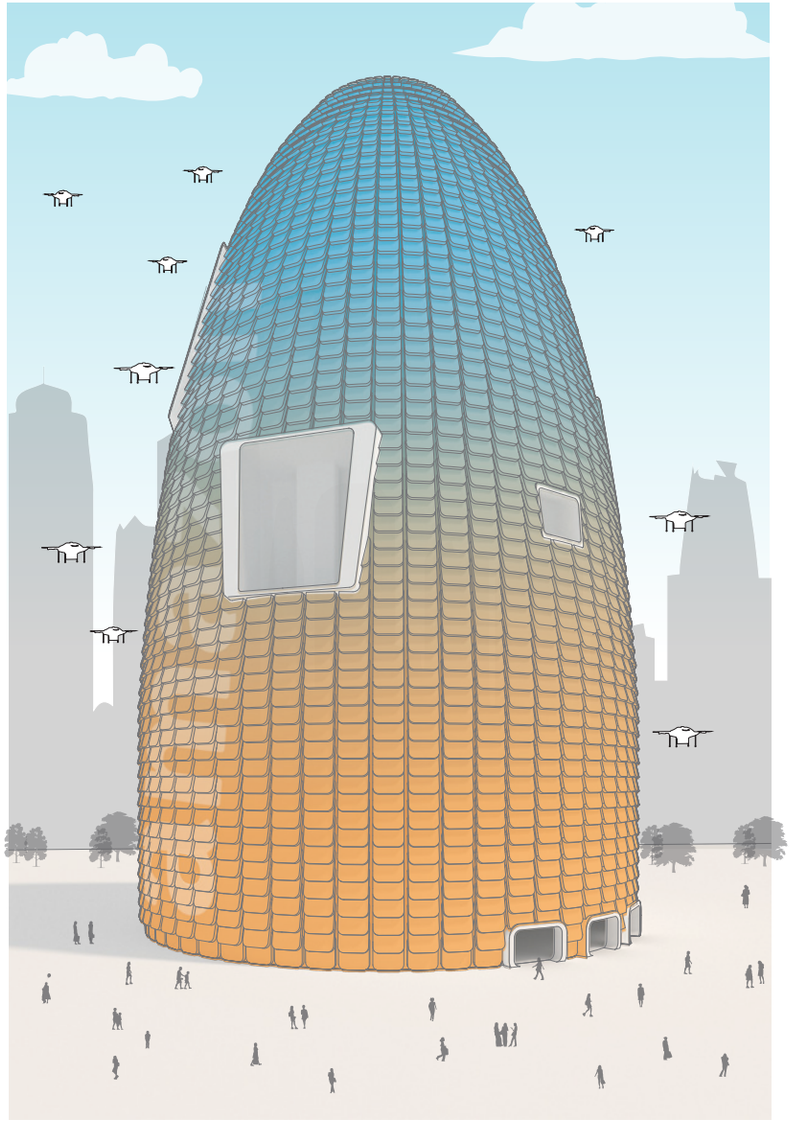


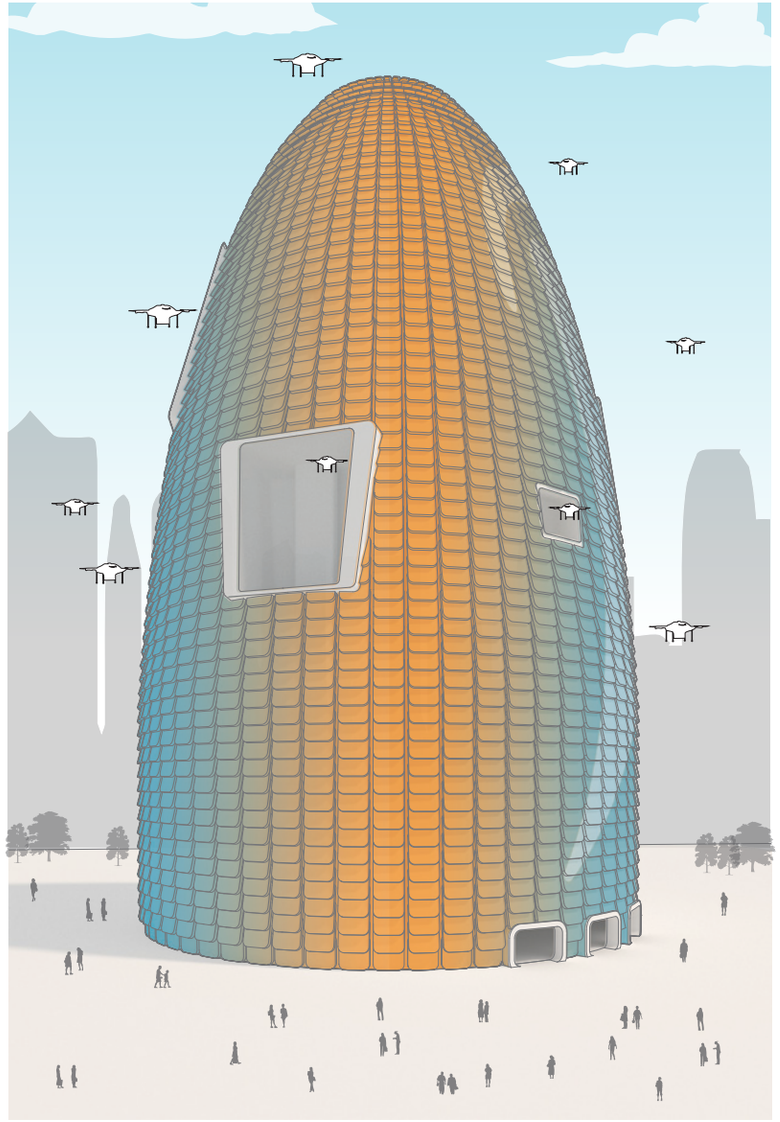
40th Floor Plan

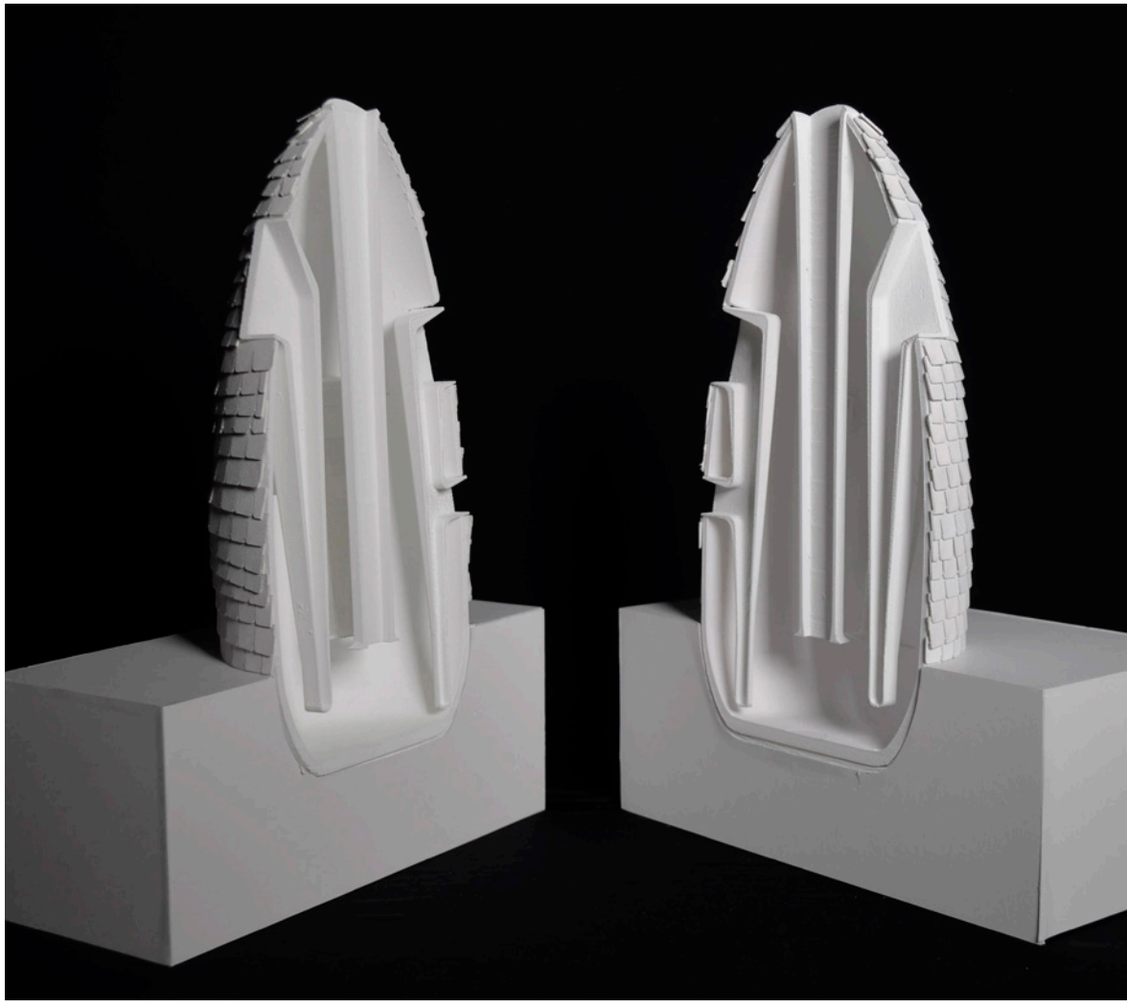


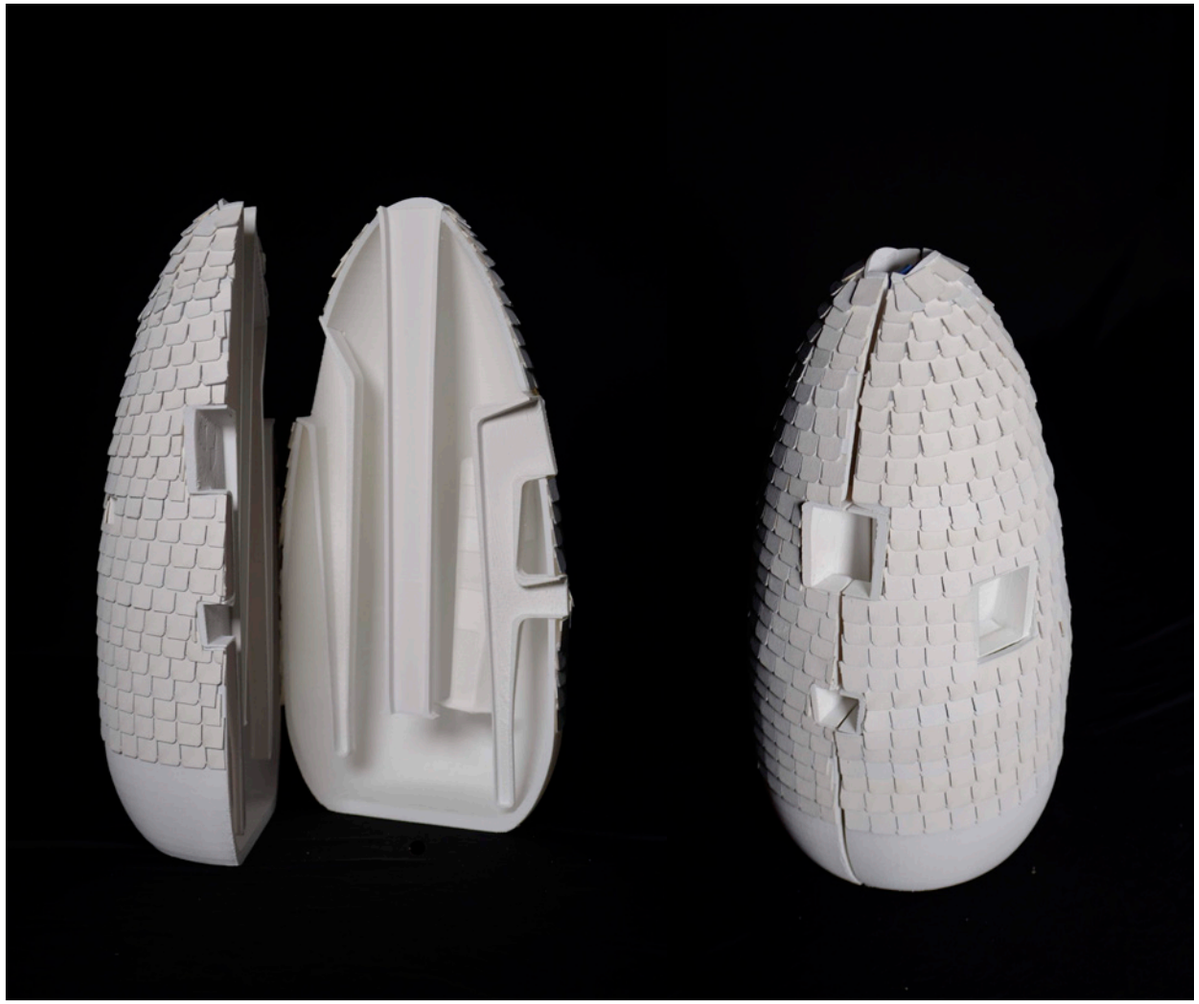
Test of elevations











Final presentation

Final models

Ackermann, Kurt, et al. Building for Industry. Watermark, 1991.
The relationship between the industrialist client and the engineering 'architect' worked together to create a new type of architecture. It talks about the methods and techniques of construction used for the new type of building that emerged during the Industrial Revolution. Even though industry has changed, the manufacturing capabilities are still a powerful force for economics. Technology is the most important factor that makes industrial buildings move forward and create new types of architecture.

Amir Djalali, Francesco Marullo, Hamed Khosravi. (2014) "Architecture of Fulfillment: A Project for Monditalia." *The 14th International Architecture Exhibition, La Biennale di Venezia 2014*

The exhibition presented at the Venice Biennale creates a narrative of a logistics worker in the warehouse of Atacama in Italy. Fulfillment centers have standardized procedures that can make a warehouse a very generic environment. The fictional character is presented through a series of collages, depicting a typical day at one of these fulfillment centers

Gu, Jinxiang. "Research on Warehouse Design and Performance Evaluation: A Comprehensive Review." European Journal of Operational Research 203.3 (6): 539-49. Web.

The article analyzes the five different components that are faced during the design of a warehouse. These are the overall structure, the sizing and dimensioning, the department layout, equipment selection and the operation strategy selection. The problem of warehouse design is that there's isn't an existing database where one can find analysis or design models to help in the development of their warehouses or fulfillment centers. The academic research done in the integrated design and operation of warehouses is almost nonexistent compared to the overall supply chain research.

Koolhaas, Rem. "Definite Instability: The Downtown Athletic Club." *Delirious New York: a Retroactive Manifesto for Manhattan.* The Monaccelli Press, 1994: pp 152-159.

This section of *Delirious New York* talks about a specific skyscraper in New York: The Downtown Athletic Club. It narrates the relations of the program which was an athletic club and the skyscraper typology. This text is helpful to identify the narrative of the building and apply it to my own project.

Kovacs, Andrew and Osman, Michael. "Patently Absurd: A Conversation between Andrew Kovacs and Michael Osman" *Pidgin Magazine,* Princenton, NJ, 2013

This reading is a conversation between Andrew Kovacs and Michael Osman about architectural patents. This will help me in the analysis of the Amazon patent drawings and what to take from these as a starting point. Architectural patents face many issues and that is explained throughout the text, as well as the discussion of well-known architect patenting their projects/technology.

LeCavalier, Jesse. The Rule of Logistics: Walmart and the Architecture of Fulfillment. University of Minnesota Press, Minneapolis;London;, 2016.

The author looks in depth to one of the biggest retail companies and what it takes for it to distribute the products they sell. He illustrates the growth of Amazon and also how the distribution center operates.

Lyster, Clare. Learning from Logistics: How Networks Change our Cities. Birkhäuser, Basel, Berlin, 2016, doi:10.1515/9783038210962.

The first part of the book analyses the different aspects within logistics that shape the urban environment. The last part contains examples of projects that apply the idea of logistics in an urban context. Logistics is behind everything in life, therefore it was important to look at this books for my research to understand the importance of logistics for Amazon.

Marullo, Francesco. "Logistics Takes Command." Log, no. 35, 2015, pp. 103–120., www.jstor.org/stable/43631622.

The essay analyses the use of the word "logistics" and how it has changed throughout time. The term has always related to organizing and planning, but it has entailed a variety of situations. The spatial devices used for the architecture of each of them is different. The author compares them to attempt to read logistics by means of its architecture and analyze its development.

Mills, Edward David. The Modern Factory. Architectural Press, 1959.

The different factors that factories deal during its design are being analyzed in this book. The author tries to make a "guide" for assistance to improve the design of factories through is structural techniques, lighting, heating and ventilation systems. Well-designed factories have proven to have a higher quality of work therefore, there are examples of factory buildings in Great Britain to illustrate the authors' points.

Rappaport, Nina. *Vertical Urban Factory.* Actar Publishers, 2016.

Vertical Urban Factory started as an exhibition and is now a published book. It relates the relationship between urban design and the integration if industry in cities. The main idea of the author is to reintegrate the vertical factory as part of the urban fabric to help cities programmatically and economically. Warehouses have also the ability to be vertical objects and can be more efficient.

Wild, Friedemann. *Centers for Storage and Distribution.* Van Nostrand Reinhold Co, New York, 1972.

The author refers to warehouses as an ever-changing station in the flow of merchandise. He exemplifies with different types of warehouses for different commodities that all warehouses function as a midpoint of storage and distribution centers. The understanding of how warehouses function and how much space and time is needed to store a good is essential for the design of warehouses.